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June 2014
Issue 403

OUR EXPERT

FIND THE PERFECT TABLET FOR ANY NEED!

TOP TABLETS ON TEST

WE TEST THE LATEST MODELS FROM SAMSUNG, APPLE & MORE — FROM COMPACT SUB-\$250 ANDROIDS, TO POWERFUL WINDOWS 8.1 LAPTOP REPLACEMENTS

TRUSTED HOW-TOs

- DIY Chromecast alternative
- Create stunning gaming videos
- Build a 10W gaming PC

RASPBERRY PI MADE EASY

Get hacking and programming the iconic mini PC with our beginner's guide

MUST-HAVE TABLET GEAR

Accessorise your slate! We uncover the best tablet-ready keyboards, gamepads, styluses, speakers & backup battery packs!



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Future

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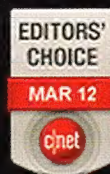
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APC is published by Future Publishing Australia.

Distributed in Australia and NZ by Network Services.

Printed by Webstar

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Time of the tablet

The variety of choice in today's tablet market is a great sign of things to come, argues APC editor Dan Gardiner.

As you've probably noticed, this month's cover story is dedicated to tablets. We've reviewed quite a few since this category took off around 4 years ago, with the release of the first iPad – and we reviewed many before then, too, back when they were mostly stylus-driven Windows models that nobody wanted. As with the iPhone, it took a dash of Apple's secret sauce to concoct the right recipe for mass-market success.

As with the iPhone however, Apple has recently found itself on the back foot after dominating the tablet scene for almost three years. Android's stolen a lot of market share and has even come to dominate in some markets. That's not great if you're an Apple shareholder, but it is good for fostering choice. That, really, is the beauty of the tablet market today – it may be a bit messy, but it's still an area that's changing. It hasn't quite found its final, comfortable form yet – whereas it could be argued that smartphones peaked last year with the Galaxy S4. (Of course, being tech lovers, we'd love to be proven wrong...) And as Darren Yates found this month, there are even some economical – and downright tempting – Windows-based tablets that could finally be worth considering. And isn't it great to finally have the choice?

NEW MASTERCLASS SERIES

Regular readers will also notice that we've added an extra masterclass this month – this one on the Raspberry Pi. Darren Yates has been covering the Arduino single-board PC (as these devices are known) for over a year and while there is some overlap

between it and the Pi, they're different enough that we thought the Pi deserved its own series.

Single-board PCs are perhaps one of the most encouraging tech trends of recent years – in a way, they take the PC right back to its hobbyist roots of the late 70s, challenging users to roll up their sleeves and code, hack and tweak for results.

But they also dovetail into another, more modern, trend – the ability to put a processor into just about anything. Thus, the Pi and Arduino are a great place to start learning the tricks of the trade for emerging digital industries, from fields as wide as robotics, home AV, the smart home and the 'internet of things'.

If you're the type of PC enthusiast who enjoys creating and tinkering, there's a lot of fun to be had with these single-board projects. But perhaps more critically, for young 'uns interested in PCs, hardware and software engineering in general, they're great primers that will undoubtedly serve them well when it eventually comes time to choose a career. The next generation of PC geeks have some truly powerful learning devices at their fingertips. Considering how far we've come in 35-odd years, starting with just the meagre home computing tools of the late 70s and early 80s, it'll be fascinating to see what the Arduino and Raspberry Pi generations can come up with!



DAN GARDINER
EDITOR
dan.gardiner@futurenet.com

Issue 403 June 14

Contents

40

FIND THE PERFECT TABLET FOR ANY NEED!

TOP TABLETS ON TEST

APC TESTS THE LATEST MODELS FROM SAMSUNG, APPLE & MORE — FROM COMPACT, SUB-\$250 ANDROIDS TO POWERFUL, WINDOWS 8.1 LAPTOP REPLACEMENTS

66

4K IS HERE

ULTRA HD IS THE NEXT-GEN PC RESOLUTION — HERE'S WHY JOSH NOREM SAYS YOU HAVE TO HAVE IT



» features

40 TOP TABLETS ON TEST

Everything you need to know about the current state of play in the tablet market.

66 4K IS HERE

Ultra HD has arrived, we look at why you might want to consider upgrading.

» technotes

6 NEWS

The latest developments in the tech world.

10 GADGETS

Hot tech gear we want to own.

12 NEWS FEATURE

The ultimate speed machines.

14 EPINIONS

See what APC's readers are talking about.

16 END USER

Not everything is plain sailing in the tech world.

"First off, you have got some gall to compare a glorious 4K display to a marketing term such as 'retina display.' 4K is here, P66



29 TESORO DURANDAL ULTIMATE GN1



29 GAMDIAS ZEUS



28 ROCCAT KAVE XTD 5.1



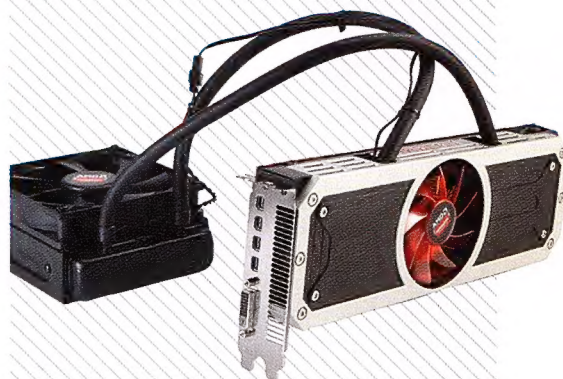
24 SEAGATE BACKUP PLUS FAST 4TB



22 EPSON EH-TW5200



24 WD MY PASSPORT PRO 2TB



18 AMD RADEON R9 295X2

» the lab

18 LATEST REVIEWS

18 AMD Radeon R9 295X2
20 HP EliteBook Folio 1040 G1
22 Epson EH-TW5200
23 D-Link DSL-2890AL/LE
24 WD My Passport Pro
24 Seagate Backup Plus Fast 4TB
26 Intel 730 vs Crucial M550
28 Mionix Avior 7000
28 Roccat Kave XTD 5.1
29 Gamdias Zeus
29 Tesoro Durandal Ultimate
30 HP Deskjet 2540
30 Canon PIXMA iX6860

34 SOFTWARE REVIEWS

» how to

74 QUICK TIPS

We fix readers' computing problems.

76 TUTORIALS

76 Encrypt files in Windows for free
78 Ditch XP and switch to Linux
82 Get started with automation
84 Free up space on your iOS device
86 Stream your own media collection from home
88 Create stunning gaming videos
91 Macros for list management in Excel

92 MASTERCLASSES

92 Building a 10W gaming system
96 Getting started with the Raspberry Pi
102 DIY Chromecast alternative
106 Digital audio recorder

» downtime

110 GAMES

High-performance playtime.

114 CHIP CHAT

News from the world of geekdom.



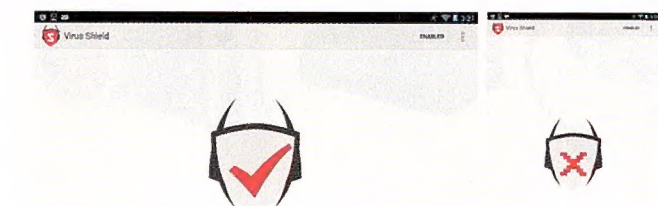
» on the disc

» Ashampoo Video Styler 2013
» 1-abc.net Search Engine Confuzer
» Abelssoft VideoCompressor 2014
» The Blackwell Epiphany demo
» Email Essentials Toolkit

Find your disc inside on page 99.

Shielding nothing but the truth

When is an app not an app? When it's an empty wrapper, solely designed to part you from your money. Peter Dockrill



An Android security app that was downloaded more than 30,000 times on Google Play has been revealed to be a complete sham. 'Virus Shield', developed by a company called Deviant Solutions (hmm... perhaps that name should have been a giveaway) sold for \$3.99 and notched up impressive sales, reaching as high as number one in the new paid apps category at one point, with a healthy user rating too, just shy of five stars. But while Android users may have been seemingly pleased with their purchase, Virus Shield – which claimed to protect devices from harmful apps by scanning them in real time – turned out to be nothing but digital snake oil.

Staff at news site Android Police decompiled the app's code and revealed that, short of displaying a simple two-frame animation that switched from a cross to a tick (supposedly indicating to the user that his or her 'Virus Shield' was now activated and ostensibly protecting their device from mobile malware), the app didn't actually do anything. Anything at all. Once the cat was out of the bag, Virus Shield was swiftly removed from Google Play, with its 17-year-old developer, Jesse Carter, later claiming to the *Guardian* that one of his designers uploaded "an early placeholder" app in error, which didn't contain any of the intended antivirus code. According to Mr Carter: "We may possibly upload the intended version of the app for free to everyone." At time of writing, Virus Shield has not yet returned to Google Play... and let's just say, we're not holding our breath.

Chance of a shower: the dangers of 'leaky' cloud storage

The convenience of easily accessible cloud storage lockers like Dropbox, Box and OneDrive is a hugely compelling reason why users flock to the services, but you've always got to be careful with what you upload to servers you don't physically control. The latest security scare over cloud storage comes with the revelation that Dropbox and Box are capable of 'leaking' users' personal files in limited circumstances where file-sharing functions are activated. In the case of Dropbox and Box, when users elect to share files, both services generate a highly unique but otherwise unprotected web link that anybody can use to access the file in question (they don't need to be a registered user or authenticate in any way).

According to security analyst Graham Cluley, these supposedly private links can easily be referred back to advertising servers via search engines, in one case disclosing more than 300 private web documents to enterprise collaboration company Intralinks. Intralinks' CTO confirmed these unwittingly exposed documents included "several tax returns, a mortgage application, bank information and personal photos. In one case, corporate information including a business plan was uncovered. We also found evidence that many people are mingling their personal and professional files, potentially presenting privacy and security concerns for organisations."





Attack of the Chromebooks

They're growing in strength.

While the conventional PC market has certainly been soft in the last few years – with tablet and smartphone uptake usually pegged as the chief contributing factor – strong sales of Google's Chromebooks have decisively bucked the trend, and if Intel has its way, the Chromebooks phenomenon won't be going away any time soon. The chip giant recently announced its plans to incorporate Intel processors in a whopping 20 models on the market this year, with a range of Chromebook (and Chromebox) systems from Acer, ASUS, Lenovo, Toshiba, Dell, LG and HP – in other words, nearly all the major players in today's PC industry. The machines will feature new Intel Celeron CPUs (based on the Bay Trail-M SoC) and even beefier Core i3 (4th-gen) processors, including the first machines to run Chrome OS in 64-bit. For a sense of the scale of growth in the Google-backed category, Intel chips powered just four PC designs on the market last year, indicating a five-fold increase in Intel-based systems year on year. Of course, Chromebooks still won't appeal to users who need to run specific Windows or Mac desktop apps, but for light, web-based consumer use – or for deployment in sectors like schools and hospitality – Chrome OS could stand to gain much at Microsoft's and Apple's expense. Plus, with the migration to more performance-focused chips clearly on the cards, who knows what tomorrow's Chromebooks might be capable of?



DVR tells all: I was a Bitcoin-mining stooge

Fears over the security implications of the 'Internet of Things' are steadily on the rise, with researchers at the SANS Technology Institute recently demonstrating just how easy it is for a web-connected device with negligible security defences to become compromised by attackers. Researcher Johannes B. Ullrich purchased a simple consumer DVR off eBay and connected it to the web with factory settings in order to lure any would-be hackers to the potential honeypot. Monitoring the device, Ullrich observed 13 different IP sources scan the DVR in just one day, with one going so far as to manually install a Bitcoin miner on the appliance! If there's any consolation to be found in this bleak scenario, it's Ullrich's observation: "I haven't seen the miner return anything yet, which probably underscores the fact that these miners are pretty useless due to their weak CPUs."



Online storage comes to the offline world... ah, what?

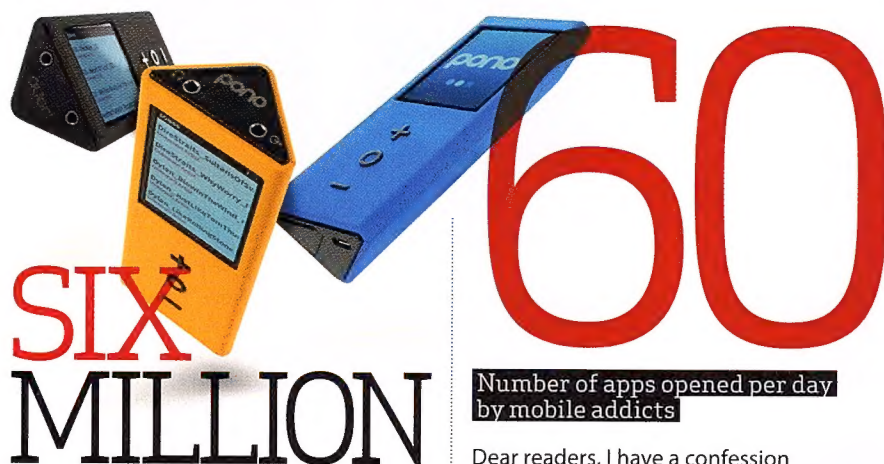
Running out of room in your house or flat? New-York-based company MakeSpace is aiming to bring Dropbox-style online storage to the real world, with a nifty service that lets you 'store your physical stuff in the cloud'. Say again? The way it works is actually pretty simple. Users sign up to the service and schedule a pickup, where MakeSpace will drop off its bins to your residence. You then simply pack the bins with what you don't have room for, then MakeSpace picks it up and visually catalogues all your gear for you, which you can later request them to deliver back when you need it again – as easily as hitting a download button. The new service is only available in the US for now, but MakeSpace's killer interface might well provide a glimpse at the semi-digitised future of external storage.





2 out of 3 mobile gamers stop playing after 24 hours

"Free-to-play" is a controversial label in the gaming industry. It describes a commercial model where a game is free to download and try out, but making substantial progress in the game — or enjoying an uninterrupted playing experience — will usually require shelling out on costly IAPs (in-app purchases). While free-to-play is extremely unpopular with many players, it's proven to be an extremely profitable model for some software makers, but a new study by app company Swrve shows it's not all good news for developers hoping to cash in: Swrve's survey of 10 million players over 90 days showed 19% of gamers only play a game once, while 66% stop playing after one day, and the average player only spends 45 cents (US) on IAPs all up. A fickle bunch.



Neil Young wins big with record-making Kickstarter project

We've discussed Neil Young's PonoPlayer before in APC — the veteran rocker's attempt to crowd-fund a portable music player with super high-quality audio for discerning audiophiles. What we didn't know is how successful it would be: all up, Young raked in a stunning US\$6,225,354, making it the third-highest Kickstarter project ever, trailing only the Pebble smart watch and Ouya game console (and edging in front of the Veronica Mars movie).

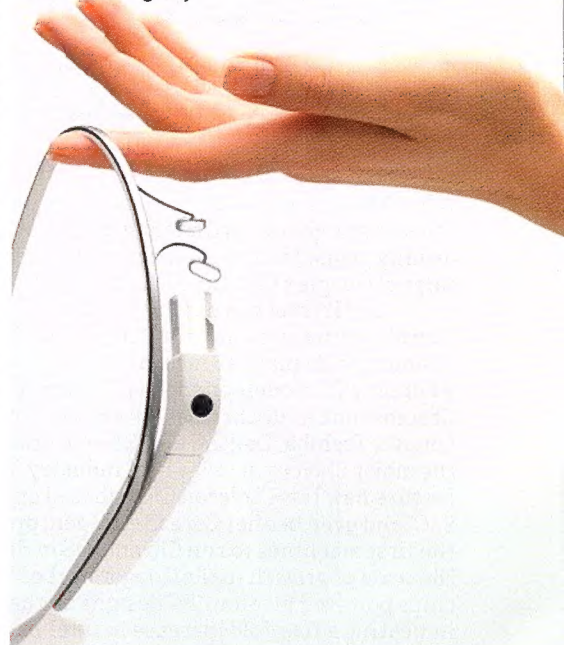
Number of apps opened per day by mobile addicts

Dear readers, I have a confession to make: I fear I might be a mobile addict. And I'm not just idly speculating either. Apparently mobile addicts are quite identifiable — according to mobile ad firm, Flurry, anyhow — being people who launch apps more than 60 times a day, whereas 'super users' take a hit between 16-60 times daily, and regular users imbibe less than 16 times per day. What's more, addicts such as myself are growing in number, with the category more than doubling in a year. Join us.

72%

Nearly three in four people are worried about the safety of Google Glass

It's still too early to pass judgment on Google Glass, the search giant's hugely ambitious wearable project that, if it comes off, could see many of us sporting augmented-reality visors in the very near future. But perhaps the biggest hurdle facing Google Glass isn't technological, but social. A recent consumer survey by research firm Teluna found that 72% of respondents would not purchase the device, citing privacy and safety concerns. For all its potential promise, if nobody wants to buy it... could Google Glass end up being the next Segway?



87%

This just in: 9 out of 10 hacks are carried out by the government

Criminal hackers get a bad rap, don't they? When digital naughtiness is detected, the media's finger of blame is invariably pointed at shady geeks wearing hoodies, and yet the latest data breach investigations report issued by US telco giant Verizon highlights that organised crime was only responsible for a paltry 11% of cyber-espionage breaches last year, with a whopping 87% of attacks coming from 'state-affiliated actors'. It's good to see our tax dollars at work, no?

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HS-210



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Browse & stream your media from NAS to TV



AirPlay / DLNA support – stream video & photos via Apple TV & DLNA-compliant devices



technotes

» GADGETS



HP SLATEBOOK 14

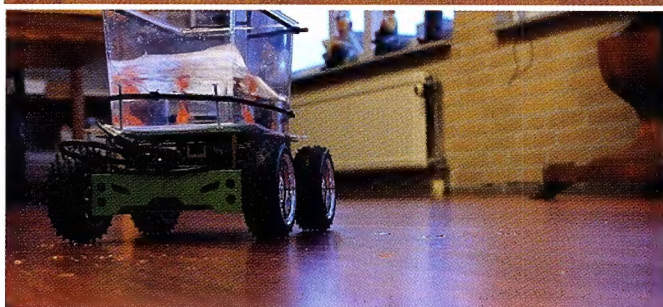
TBC | WWW.HP.COM/AU

Excuse the grainy photos, but at time of writing HP hadn't officially announced the Slatebook 14, although some details (and these images) were accidentally leaked on the company's Italian web site a tad early. Aside from the bright yellow trim, the Slatebook 14 might not look all that different from any conventional 14-inch laptop, but this is no regular machine: the Slatebook 14 is a full-size notebook that runs Android (yep, Android). Not Windows. Not Chrome OS. Not Linux. It's your smartphone's OS, now blown up to PC proportions — and with a massive touchscreen to complement the keyboard and trackpad. The Slatebook 14 is actually HP's second Android Slatebook device, with the former entry being a hybrid Android tablet. Will we see more of these Android notebooks, will users flock to them, and what does this all mean for Microsoft? Time will tell.

FISH ON WHEELS

TBC | WWW.STUDIODIIP.COM

The amazing thing about crowdfunding is that people can invent anything they want. And what they want to invent is: Fish on Wheels. This aptly named contraption, which is currently in funding on Kickstarter, uses a camera coupled with an Arduino system to create an "aquarium on wheels that enables fish to drive wherever they want to go". (This statement alone raises all sorts of interesting philosophical questions.) As Fish on Wheels' designers put it: "Finally some freedom for our aquatic pets that have so far been limited to their fish tanks!" We'd like to point out that, as far as we can tell, any fish drivers in question will still be limited to their tanks, but hey — at least they can park them wherever they like in your house, apartment or office. Location is everything, just watch out for stairs.



VEHO PORTABLE MICROSCOPE WITH LCD SCREEN

\$300 | WWW.VEHO-WORLD.COM

USB microscopes have been available for less than \$50 for the last few years (we occasionally use one in labs testing to take a squiz at screens up close), so what makes this unit special? Well, it's got a fancy stand for one, a built-in battery so it can work anywhere, and a screen so you don't need to hook it up to a PC to use (though you can if you want to). The specs are reasonable — the scope packs a 5-megapixel digital camera with an optical magnification of up to 300x, although details on the display itself are scant; it's 3.5-inches and 4:3. That doesn't quite seem to add up to a \$300 price tag, but we'd still like to get our hands on one to find out.



ROUGH RIDER LEATHER MESSENGER

FROM US\$335 | WWW.SFBAGS.COM

If Indiana Jones owned a laptop, he'd probably carry it in a Rough Rider. Available for 13-inch and 15-inch notebooks, this bag is certainly built to last. It's made using a 1940s machine so powerful it can sew a penny onto a piece of wood. Its adjustable strap feels comfortable, but some might bemoan the minimalistic interior. There are two pockets under the front flap and two on the inside, but no padding or separate section for your computer. Whether this is good or bad is, of course, a matter of personal taste. And then there's the price — to which you'll need to factor in about US\$20 for international shipping.

XBOX ONE STEREO HEADSET ADAPTER

\$39.95 | WWW.XBOX.COM

We don't normally get excited about adapters over here at APC but this isn't just an adapter; it's a key to comfort and freedom of choice. This slick little piece of kit plugs directly into the bottom edge of the Xbox One Controller and — after a small firmware upgrade — allows you to use any compatible headset for almost wireless (you're still tethered to the controller) audio and comms. As long as your headset uses a single 3.5mm jack (instead of separate green and pink variety) you're good to go. No more being bound to awful proprietary units or the handful of third-party options that traditionally don't regard fidelity as highly as APC readers.



LINKSYS WRT1900AC

\$295 | WWW.LINKSYS.COM

Linksys's iconic WRT54G 802.11g router was released over a decade ago, a boxy little router that, even back then, could be charitably described as "ugly as sin", but what it lacked in looks, it more than made up for in performance and hackability. The WRT54G was one of the routers that helped spawn popular community-created firmwares like DD-WRT, OpenWrt and Tomato. (Heck, the thing's even got its own Wikipedia page!) Well, the old warhorse finally has a successor in the WRT1900AC, which keeps the original's affinity for open-source firmware but updates the internals with state of the art networking tech, including (as you expect from the name) 802.11ac Wi-Fi. So can it possibly live up to its 802.11g predecessor's reputation? We'll let you know as soon as we've put one through its paces. ■



THE ULTIMATE SPEED MACHINES

Feel the force of the supercomputers that are incomprehensibly smart. **Dr Michael Banks** explains.

US supercomputer Titan is currently the world's second fastest, beaten by Tianhe-2.

Meet Titan, one of the fastest supercomputers in the world. It's the second fastest to be exact. Its power is the equivalent of the world's 7 billion people carrying out three million calculations per second.

Its staggering ability is down to its 'hybrid' architecture. It has over 18,000 central processing units (CPUs) – the processing brains inside a computer – and an equal number of graphical processing units (GPUs), the circuits that bring video games to life. The GPUs are adept at parallel processing – handling large amounts of data at the same time.

Housed at the Oak Ridge National Laboratory in Tennessee, US, Titan's massive brain is being deployed on science projects – working through the intricacies of molecular-scale physics and predicting how our climate will change. It became the world's

fastest digital brain when it was switched on in October 2012, but it didn't hold on to the top spot for long.

By the time the TOP500 list of the world's fastest supercomputers was published in June 2013, it had been



Tianhe-2 is expected to remain in the top spot for just six to 12 months.

beaten by Tianhe-2, based at the National Supercomputing Center in Guangzhou, China.

Tianhe-2 can run at a whopping 33.86 petaflops per second. That's the equivalent of 33,860 trillion

calculations every second and nearly double the processing speed of Titan, which runs at 17.59 petaflops per second. Developed by China's National University of Defense Technology, Tianhe-2 is packed with over 3 million Intel processors.

Tianhe-2 has been given an eclectic mix of tasks including controlling traffic lights, predicting earthquakes and developing new drugs.

"In many ways it's being used as a flag for Chinese innovation and technology," says Dr Andrew Richards, associate director of the Oxford e-Research Centre at the University of Oxford in the UK.

"It's a power race between the US and China to be number one," he says.

While we are currently in the era of 'petascale' computing, by 2020 it's predicted we'll have entered the 'exascale' age, with computers that are 1,000 times faster again.

5 FASTEST SUPERCOMPUTERS

NAME	WHERE	SPEED (PETAFLIPS/SECOND)
TIANHE-2	NATIONAL SUPERCOMPUTING CENTER (CHINA)	33.863
TITAN	OAK RIDGE NATIONAL LABORATORY (US)	17.59
SEQUOIA	LAWRENCE LIVERMORE NATIONAL LABORATORY (US)	17.173
K COMPUTER	RIKEN (JAPAN)	10.51
MIRA	ARGONNE NATIONAL LABORATORY (US)	8.586

Random matter

Today's weather forecasts rely on supercomputers. The Met Office's IBM computer in the UK can perform over 100 trillion calculations per second.

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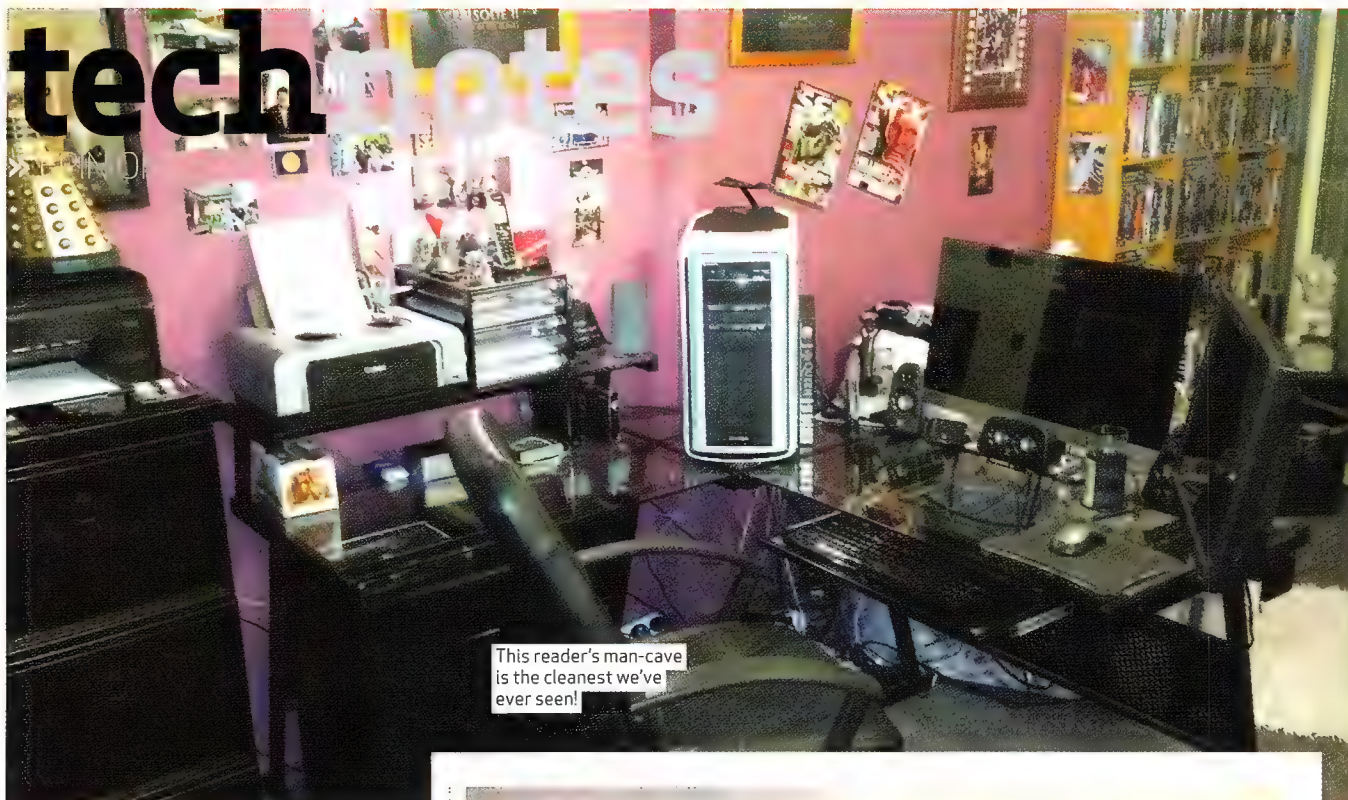
Designed for great sounding, rich audio.



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hp.com.au/x360

technotes



ALL THE STUFF!

I couldn't resist your invitation to show what I do with the old gear that holds a special place in my heart. I have created a museum over the workbench in my man-cave, the bench that I used to use for building clients' computers. In the image (right) you will see mounted on the wall of fame the following: A recently retired GA-890GPG-UD3H motherboard, an Athlon XP chip, a Phenom X2, two Motorola Razor phones, a Samsung HD-Icon phone, a Galaxy S2, a Galaxy S4, a Garmin-ASUS Nuvifone, a 1GB Mega-drive, and the keyboard from an Acer Aspire One that my wife destroyed. To top it off there's also a Gigabyte GV N560C video card that was recently replaced by a 760GT.

The elderly PC in the picture is running an old Phenom X2 and Mint 14 just for the hell of it. Yet another Galaxy S2 is next to my bed running Paranoid Android (Kit-Kat naturally) and serves as my alarm clock.

On the other side of the cave is my current system (an aging Phenom 1090T watercooled at 4.1GHz). To give some sense of scale the centre screen is a 27-inch AOC and the other is a 24-inch HP that's in service despite its age!
Peter Henderson



KEEP WINDOWS XP FOREVER?

In the May issue of APC (page 88), Chris Lloyd talks about being absolutely sure you won't be compromised, just go offline! There is no direct mention around keeping antivirus definitions updated for the offline machine. While the machine won't be compromised to the outside world the OS itself could be via a USB or Network transferred virus. Networking it to the main system could make it even worse if the XP machine has a virus and the main machine is used to access the internet.

There is mention of AVG continuing support, but that is mentioned with the

expectation that you wish to use this machine online.

Also, now that it's unsupported, we know Microsoft won't create a fix for XP for the latest IE vulnerability.

(tinyurl.com/mu37dpu)
David

Ed replies: Shortly after this email from reader David, Microsoft confirmed that it was releasing a fix for the XP version of Internet Explorer (alongside fixes for other Windows editions) via Automatic Update. So XP users, make sure you grab it if you haven't already. ■

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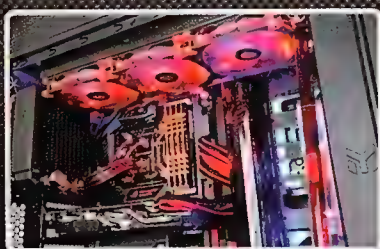
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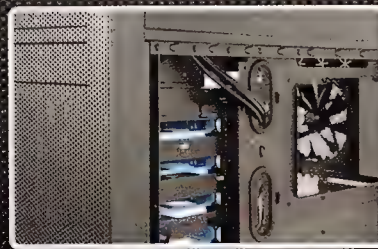
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The Heartbleed dilemma

Changing your passwords is the first step, but that alone won't necessarily nix the Heartbleed bug, says Peter Dockrill.

Just as we were going to press last issue, news broke of a hugely serious encryption vulnerability called the Heartbleed bug, which affects the OpenSSL library designed to provide security for numerous web sites, email services and more. While

OpenSSL isn't used by every web site or company for encryption purposes, it's still an extremely common and popular encryption toolkit, with estimates that close to one in five web servers worldwide had implemented susceptible OpenSSL code at the time the vulnerability was discovered (in early April).

The kinds of companies exposed here are big names, too: Google, Instagram, Yahoo and Dropbox are among the list of institutions that utilised the vulnerable OpenSSL code. While any such reputable organisations have since updated their OpenSSL implementation with a security patch that remedies the bug, security experts are advising it's theoretically possible that users who signed in to any compromised web services in the past two years may have had their credentials logged.

In other words, your username and password for email services, social networking sites, cloud storage providers and other web sites may have been recorded, which theoretically could give interested parties log-in access to any such web accounts. Accordingly, the advisable course of action for any concerned readers is – if you haven't already done so – change your passwords for any sites that you think might have been affected by the Heartbleed bug. Password management company Lastpass has set up a convenient Heartbleed checker site (<https://lastpass.com/heartbleed/>) that detects what sites are (or were) vulnerable to Heartbleed, and you can find further detailed technical information on the bug and related FAQs at Heartbleed.com.

While Heartbleed is an extremely serious bug, some security

commentators have pointed out that it's unlikely many users have been affected by the vulnerability, as it's thought that few if any potential hacking agents were aware of the issue before April this year – at which point Heartbleed's existence was widely publicised and web site operators rushed to update their servers. But the whole calamity just goes to show how exposed users are on the web and, pragmatically speaking, the ultimate futility of 'internet security' in extreme cases such as this, when both users (protecting their passwords as best they can) and site operators (implementing industry-standard encryption protocols) follow best-practice guidelines and still end up exposed.

Indeed, the most dire ramifications of Heartbleed may still lie ahead. While the immediate user credentials issue for popular web sites can largely be remedied by users updating their passwords (in tandem with web sites patching their OpenSSL implementations), it's been suggested that the much more serious, still unaddressed issue could be the millions of web-connected hardware devices out in the wild – printers, modems, routers, webcams, media players, storage systems and more – that rely on OpenSSL in part for their secure operation. You and your family may well run a number of such affected devices in your home. Until users everywhere manually download and update the firmware on each of these susceptible units and appliances, Heartbleed isn't going anywhere. ■



"The most dire ramifications of Heartbleed may still lie ahead."

ENDUSER

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AMD RADEON R9 295X2

Taking aim at the 4K gaming horizon with both Hawaii XT barrels.

Whenver anyone releases a new GPU, two things happen. The first is that someone will inevitably pipe up, post-ironically asking the tired "Yeah, but can it play Crysis?", and the second is that we'll all start to wonder what it would be like if you strapped two together.

That's how graphics card engineers operate too, so once they've smacked down the Crysis talks, they start designing an effective solution for jamming two high-performance processors onto one PCB.

We've got the fruits of those GPU engineers' labours: the Radeon R9 295X2, it's quite a card.

The R9 295X2 arrived in early April, proudly sporting a pair of Hawaii XT graphics processors and all its LEDs and Radeon branding twinkling. It's also the first reference design card to sport a liquid cooler. A smart decision, and one that only adds to the ultra-enthusiast class aesthetic.

So yes, this is effectively a pair of R9 290X GPUs on one card, which is exactly why it needs such hefty cooling. The Hawaii XT GPU is one powerful slice of silicon, but it's also an incredibly hot one. AMD's Graphics Core Next (GCN) architecture is not quite as energy efficient as Nvidia's Kepler design. In order to compete with Nvidia's GK110 GPU, AMD needed to make a massive GPU to fit all the GCN cores it needed to catch up. And that size, as well as the 1GHz clockspeed touted by the R9 290X, means it generates a whole lot of excess heat.

To be fair, when you strap a pair of high-end GPUs of any sort onto one board you're going to need some hefty cooling. Generally what happens is the processors are down-clocked to run slower than in their single-GPU configuration. This is what's happened with all the dual-GPU cards we've ever tested, and incidentally that's also one of the reasons Nvidia's upcoming GTX Titan Z looks like it could be

irrelevant. A pair of GTX Titan Blacks are going to be some \$1,000 cheaper and, with the full-fat clockspeeds of single-GPU cards, are probably also going to be quicker too.

But those clockspeed shenanigans haven't happened with the R9 295X2. AMD has actually boosted the core clock of the twin Hawaii XT GPUs at the heart of this card from the 1GHz of the R9 290X up to a heady 1,018MHz. Granted, that is a measly 18MHz speed bump, but we'd have still been impressed if AMD had simply kept with the same clockspeed. On the other hand, Nvidia's Titan Z is likely to be clocked slower than the GTX Titan Black GK110 GPUs on which it's based. The Titan Black is running with an 889MHz baseclock – we expect that to be far closer to 800MHz when it comes to the chips inside the Titan Z.

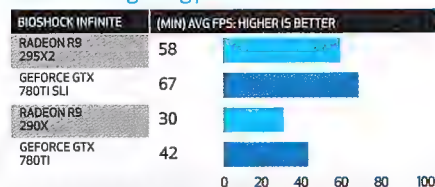
Is the R9 295X2's clockspeed a result of attaching that closed-loop liquid chiller, or did the

decision to retain the 1GHz Hawaii XT speed come first? We're not sure, but either way, we've still got a quiet, cool and, importantly, quick pair of graphics chips making the R9 295X2 the current fastest graphics card in the world.

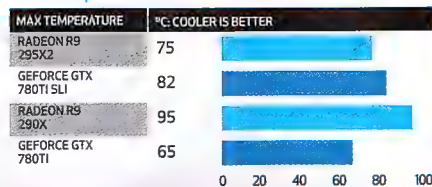
Yes, what we've got here is another ultra-enthusiast class graphics card, and that means a crazy-high price tag. As a result of being announced after Nvidia's insane \$3,000 Titan Z, it does seem far better value. Applying the notion of 'value' to a single component that costs over a grand seems insane, but still, we're talking about the bizarre world of the ultra-enthusiast component – a place where money seems not to matter, and generating a worldwide techgasm from the great and the greedy of the technology world is the only aim. Let's be clear, what we have here is more a 'proof-of-concept' than a graphics card any of us is ever likely to own. You're going to see these cards at AMD-sponsored

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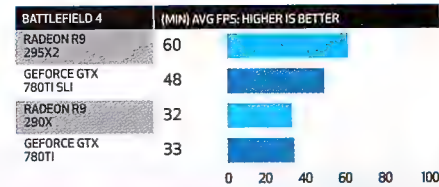
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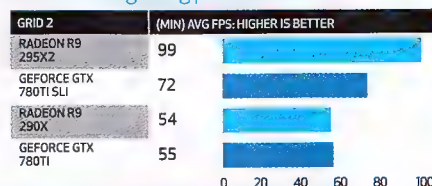
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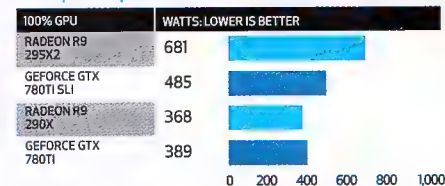
DirectX 11 4K gaming performance



DirectX 11 4K gaming performance



Peak power performance



"What we've got here is another ultra-enthusiast class graphics card, and that means a crazy-high price tag."

exhibitions, LAN parties and pro-tournaments, not in your best buddies' rigs.

That 1GHz+ clockspeed is impressive, but so is the rest of the specs list. Two Hawaii XT GPUs have a full 5,632 Radeon cores/streaming processors between them, with 4GB GDDR5 and a 512-bit memory bus dedicated to each GPU. That vast amount of memory means that this is probably going to be the easiest way to get a good gaming at 4K and that's another of the major targets for AMD's R9 295X2.

Currently, the only way to get genuinely playable 4K frame rates at the highest graphical settings is to run a pair of GPUs with a big chunk of graphics memory. Even the GTX Titan Black isn't going to offer a consistently playable experience with all its super-powered GK110 silicon. You could argue that's largely irrelevant given the paucity of 4K gaming screens, but it's still one for the marketing presentations and graphics card willy-waving.

The issue is that with the premium pricing, it'll be cheaper and easier to source a pair of R9 290X cards to create a CrossFireX setup to rival the R9 295X2. You will need a beefy PSU with enough PCIe connectors to run the two cards, but this

dual-GPU AMD behemoth still wants a kilowatt supply and 12V rails for each 8-pin PCIe power connector capable of delivering 28 amps or more.

You're also going to be able to make the same argument for an SLI setup with a pair of GTX 780 Ti cards strapped together in a mockery of the Titan Z.

This has always been part of the problem with dual-GPU cards. In situations where the GPUs are clocked slower than their single-GPU counterparts, the competition inevitably comes from within the same stable. When you've got such premium pricing, making the multi-GPU card more expensive than the sum of its constituent processors is difficult to justify.

While the twin R9 290X cards can't beat the R9 295X2 in terms of performance, they can at least achieve parity for a lot less. A pair of Nvidia-based PNY GTX 780 Ti cards are also cheaper than this dual-GPU beastie, and a bit quicker than two Hawaii XT chips. Well, they are until you start throwing pixels around at 3,840 x 2,160. As we said earlier, the target for the R9 295X2 is largely to nail 4K gaming, and even Nvidia's finest GPUs aren't able to keep up with the AMD card's might at such eye-

wateringly high resolutions.

At lower resolutions, the power of the combined GK110 chips breeze past the dual-GPU Radeon in the frame rate drag race, but that huge 8GB frame buffer and twin 512-bit memory buses mean that the R9 295X2 has got another gear to shift into, and leaves the Nvidia cards choking on its 4K dust.

In *Battlefield 4*, the multi-GPU card has got the beating of the GeForce pairing by some 25%. That's quite a pasting, and one that only gets worse when you look at *GRID 2*. Only Unreal Engine 3 gives the green side any good news, with Nvidia's SLI pairing getting a 4K lead in *Bioshock Infinite*.

The Titan Z will come with another freakishly large frame buffer kitting out its twin GK 110 GPUs, so it ought to have something to say when it comes to 4K gaming. But that something is probably going to be inaudible, given that its privileged mouth is stuffed with caviar... it's an altogether different class of graphics card and will struggle to have any relevance to any of us. It's crazy to be talking about a \$1,900 graphics card as the plucky value option, but in comparison with Nvidia's upcoming dual-GPU card that's exactly what it is.

It's probably best that the R9 295X2 remains out of reach and stays in the realm of the cash-rich ultra-enthusiast, or exhibition hall. The new AMD reference design may be far more stylish, with its Titan-aping brushed-metal shroud and closed-loop water-cooler keeping it chilled and quiet, but it's by no means the ultimate in gaming setups. You can put together cheaper R9 290X arrays. That leaves the R9 295X2 as a luxury for those wanting a 4K-capable mini rig.

So, although it's a fantastic performer at 4K resolutions for a single card, it's inevitably far too rich for our blood considering such pace is already available for less cash, albeit in less convenient dual-card configurations.

In terms of engineering, the R9 295X2 is a thoroughly impressive beast. It's the current fastest card around, but it's the fact that AMD has managed to get a pair of higher-clocked Hawaii XT chips onto a single board without melting a hole through space and time that really stands out. It's quite an incredible achievement.

■ Dave James

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Impressively engineered, with outstanding 4K performance, but you pay through the nose for it.





\$1,800 (AS TESTED) | WWW.HP.COM/AU

HP ELITEBOOK FOLIO 1040 G1

HP's built this ultrabook exclusively for business users, but will they bite?

HP may be reaching in its description of this laptop as "the world's slimmest enterprise ultrabook" – after all, when you've got to go two subcategories deep into the laptop market to find what sets your product apart, it might be time to look at other areas it excels. But then, the enterprise market is one that can benefit the most from having thin and light laptops that can easily travel with workers.

So what makes the Folio 1040 G1 an enterprise class laptop, exactly? Primarily, it's the bulked-up security features – such as a fingerprint reader and smart card slot – and a dedicated docking slot on the bottom. There's also an adapter cable that adds Ethernet and VGA ports in the box as standard, and the option of switching out Windows 8.1 for the older

Windows 7 (64-bit), which is what was installed on our test unit. Add to that two USB 3.0 ports, a microSD socket, full size DisplayPort output and dedicated buttons for instantly muting sound or enabling/disabling Wi-Fi and Bluetooth – great for saving battery life or for frequent fliers. Inside the entry-level model we tested was a dual-core Core i5-4300U, 4GB of RAM and a 128GB SSD – enough to do the basics, in other words – but you can spec up to a faster processor, more RAM and larger drive if desired.

Apple's MacBook Airs are essentially the benchmark that all ultrabooks have to live up to, so how does this new EliteBook compare? Quite well overall, actually.

While it doesn't quite have the Air's reassuring all-metal robustness, the Folio's chassis is built using a mix of plastic and metal that's quite

common in other Windows ultrabooks. That still adds up to an exceptionally thin and sturdy machine – the metal keyboard deck and lid combine to help keep everything rigid, but the weight is kept down (1.52kg) by using a plastic screen surround and base. The keyboard is actually a smidge wider and taller than the Air's, with fractionally larger main alphanumeric keys – though the spacing in-between isn't quite so large. It's comfortable and sturdy to type on, though we did feel the keys could use a little more resistance.

The trackpad is an... interesting... one. Its MacBook-like finish on the surface provides just the right amount of resistance under the fingertips, but what's odd about it is that there are no buttons at all – not even the pad itself can be clicked – instead it's

pressure-sensitive so, for example, if you press down hard enough on the lower right corner, it will register as a right click. It takes some getting used to the lack of physical feedback, and even after a solid week we weren't quite comfortable in getting buttons to fire consistently.

The 14-inch display – an LED-backlit TN panel – runs at a comfortable 1,600 x 900 pixels. It's not the greatest panel around for colour accuracy or providing clean and clear images – there's a bit of telltale sparkle from the antiglare coating and, if you peer close enough, you can see faint vertical bands running through the screen. Front-on, it's an acceptable display for business tasks, but it pales in comparison to the IPS screens you'll find in some of ASUS's ultrabooks.

In terms of performance, the Folio is roughly on par with other entry-level ultrabooks, though it did turn in a very solid battery life of 4 to 5 hours (under PCMark 8's Home and Work tests, respectively) – that's not quite MacBook Air good, which stretched to 7 hours in the same test, but a good 30 to 40 minutes above what most other Windows ultrabooks offer.

The bottom line? It's a decent option for business' that need the extra security, but the high price (especially at its \$2,499 RRP) doesn't quite match up to the entry-level hardware under the hood. ■ Dan Gardiner

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

A solid entry-level ultrabook for the enterprise market, but the price needs to be lower.



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EPSON EH-TW5200

Very close to being a serious gaming beamer, but not close enough.

We've not had much luck with projectors of late. OK, a projector is a tricky ensemble of optics and electronics, so there's plenty to get wrong. Even a basic setup often takes a little more nous than merely flicking the switch on a monitor or HDTV. Even so, our recent run has been inauspicious. A few issues back, the temptingly-priced BenQ W1500 was disappointing due to its rainbow effect. The Optoma HD2SLV reviewed in our sister publication *TechLife* (April, page 45) was also flawed with a double whammy of rainbow effect and extreme fan noise.

Third time lucky for Epson's gaming-centric EH-TW5200 then, or the last in a trio of duds? Actually, it's somewhere in between, which makes it comfortably better than the rest but not quite a no-brainer.

In usual Epson style, this is an LCD rather than DLP model. Not that we're

automatically biased against LCD; in fact, for gamers in particular, LCD has a clear advantage in terms of the absence of the dreaded DLP rainbow effect. It's a problem that's most apparent when you have fast-moving images and the viewer rapidly shifting their point of gaze across the screen, which is pretty much exactly what happens in a lot of games.

NO RAINBOW

Basic specs involve a full 1080p native resolution, 2,000 lumens brightness and 15,000:1 dynamic contrast. Other highlights include its compact proportions. It's not a micro projector, but it's pretty portable. It also sports an MHL port, the better to hook up smartphones and other mobile devices if that's your bag, as well as an IR remote.

Then there's a low-lag feature designed specifically for gaming. Not that we've ever really found lag to be an issue with LCD projectors, but it's nice to see

such attention to detail. Oh yeah, one other thing: this is a fully 3D-capable projector and comes with a set of radio frequency active-shutter glasses. Put it all together and you have a very attractive package for a whiff over \$1,000.

So what's it actually like? First, the contrast. Oh dear. Even among LCD projectors, we've seen models with superior static contrast. With the dynamic contrast feature disabled, contrast and black levels are pretty horrid at best.

What's more, enable the dynamic iris feature and you'll find it sluggish to respond, even in its fastest setting. It's not aggressive enough, either. When rendering a really dark scene it's fine, but for your typical night scene – most of *The Dark Knight*, for instance – it lets too much light through, washing out the blacks and compromising contrast.

Making matters worse, brightness across the image is uneven, giving a visible

gradient from left to right. At this price point, of course, one can hardly expect perfection. We wouldn't mark the TW5200 down for having simple optics without image-shift capability, and there's no doubting that this is a bright, vivid and responsive beamer, making it great for gaming much of the time. Sadly, contrast and brightness uniformity issues mean that it struggles to render the finer details of the 3D functionality, and ultimately make it difficult to recommend.

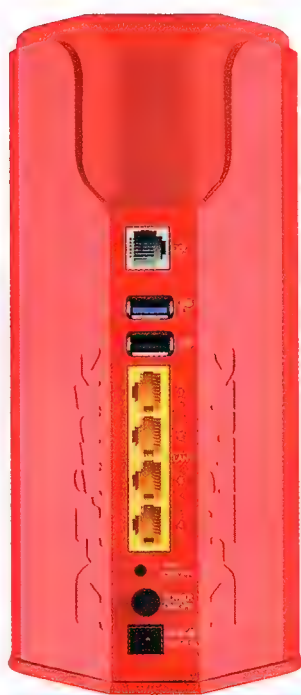
■ Jeremy Laird

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★☆☆

Fantastic feature set includes active-shutter 3D and high refresh, but contrast performance is a bummer.





"Router interfaces have come a long way in the last decade, and D-Link's are some of the best examples of that."

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D-Link DSL-2890AL/LE

Do red ones really go faster? We set about finding out...

D-Link's DSL-2890AL has been out since last year, but somehow it's managed to miss inclusion in the round-ups and reviews we've done here at APC. So we took the opportunity of the release of a new limited edition version – which is essentially identical to the normal version, but comes in bright red – to give it a test run. (Don't worry, it's also available in a more discrete black version.)

Even two years in, 802.11ac routers with built-in ADSL modems are fairly thin on the ground, so it's something of a relief that the DSL-2890AL is a relatively good option. It combines solid wireless performance with an easy-to-use web interface and a good spread of features – all at a fair price.

Despite not being the newest router around, things are reasonably impressive from a hardware standpoint – like the bulk of 802.11ac routers, this one's based on a

Broadcom chipset and comes with four Gigabit Ethernet ports (you can reconfigure one of these as a WAN port for hooking into the NBN) plus one USB 3.0 and one USB 2.0 port for plugging in storage devices or a printer. (There's a caveat to using that USB 3.0 port for storage – D-Link's interface warns you that it "may" interfere with 2.4GHz wireless performance. Thankfully, you can switch the port to USB 2.0 mode, which is still fast enough for even the most demanding media streaming.) There's also tweaker-pleasing features like a hardware power switch (no more yanking the power cable!) and dedicated Wi-Fi on/off button.

Router interfaces have come a long way in the last decade, and D-Link's are some of the best examples of that. The web interface here is one of the easiest to use, making initial set up easy, but also providing detailed and helpful configuration tips and information for advanced features. This is

displayed off to the right-hand side of basically every setting page – and it's all in well-written, easy-to-understand English so even relatively novice networkers can figure out what each setting does. It's even good at suggesting settings – warning you with a pop-up, for example, if you try to leave the Wi-Fi settings page without turning on security.

It's not lacking for software features either. You can run both DLNA and iTunes servers from connected USB devices and also share USB drive files with PCs via the standard Samba protocol. There's reasonably fine-grained control over network prioritisation in the quality of service screen, with some preconfigured rules already in place (prioritising YouTube traffic highly to avoid streaming problems, for example) and you can even specify what percentage of your connection each of the four priority settings is allowed to hog. Likewise there's

better-than-average control over network access, with web site filtering and scheduled network access times that can be applied to specific devices – you could prevent a specific PC from accessing a certain web site and shut down its access completely between 10pm and 6am, for example.

What about performance? In our 5GHz 802.11ac tests, we pitted it against our current favourite, the Netgear Nighthawk R7000. The latter also uses a Broadcom chipset, but it's a newer one running at a higher speed. Not that we could really tell. At medium and long distance testing, both routers provided very similar speeds – around the 25-30MB/s mark. It was only when tested within line of sight at 3m away that the R7000 really showed up the DSL-2890AL in any appreciable way – and then, only in one of our two tests. That involved sending our 1GB test file from our wireless client back to our Ethernet-connected server, and here the D-Link average 36.7MB/s, whereas the Netgear scored 47.4MB/s. In our book, that's still plenty of performance on D-Link's side – unless you're frequently copying large files over Wi-Fi at very short distances, you won't notice any difference.

All up then, despite it's age, this is still a stellar ADSL-capable 802.11ac Wi-Fi router. If you're looking for a do-all device, this is an easy choice. ■ Dan Gardiner

Verdict

Features ★★★★★
Performance ★★★★★
Value ★★★★★

An impressive all-in-one modem/router that still offers great performance. Red might not go faster, but it's fast enough.



* Lower is better.

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EXTERNAL HARD DRIVE

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WD MY PASSPORT PRO

A good performer, at a premium 'Apple' price.

We've seen a number of dual-drive desktop storage units over the years, but never a portable model.

WD's My Passport Pro is a left-of-field option – it's a Thunderbolt-only design, so it's essentially for Mac users only. It's aimed at content creation professionals who need a lot of storage and a quick way to move the content about or back it up. And speed really is the key selling feature here. The Pro is quite a bit bigger than your average portable drive, but that's because the tough metal chassis contains two RAIDed laptop drives. By default, those are set up as RAID 0 to enable super-fast transfer speeds at near-Flash levels. And if you want redundancy, you can use the included configuration app to reformat the drive for mirroring, saving you from disaster should one of the Pro's two drives die. The Pro is fairly neatly designed, with its power cable built-in and slotting neatly into a

rubber channel wrapped around the edge, so you'll never lose it. There's a fan in back for cooling, though it rarely fires up – we got two-thirds of the way through our 300GB Time Machine test before it switched on. Although when it does, you'll know about it. It's about as loud as your average laptop fan. The Pro is, as advertised, very fast – compared to WD's My Passport Ultra, it fairly consistently halved copy times for both single-file and multi-file batch tests. The main downside? It sells at a 'pro' price. Apple offers the 2TB model for \$400, and the 4TB unit will set you back \$550. It makes Seagate's \$400 4TB model, look like a relative bargain.

■ Dan Gardiner

Verdict

Lives up to its promises, but unless you need the option of RAID 1, Seagate's is easier on the wallet.



SEAGATE BACKUP PLUS FAST 4TB

Speedy performance for much less than WD's Passport Pro.

Seagate's Backup Plus Fast is another compact storage unit that houses two drives, also configured in RAID 0 – which, as with the My Passport Pro, is how it's able to achieve those super-high 200MB/s+ transfer speeds.

The main difference is that it uses the far more common USB 3.0 interface, so it's good for use on almost everything with USB. The downside is that, to get enough power for it to work on older USB 2.0 ports, you'll need to use the included Y-shaped USB cable and plug it into two USB ports. Unlike the WD, there's no option to reconfigure the RAID setup for better redundancy using mirroring – there's no app to check the configuration and RAID health of the drive. The Seagate Dashboard 3.0 app is included though, and great for managing backups – in our April issue round up, we found that this was the best bundled backup software of any external drive on test

(with WD's a close second). Dashboard offers real-time backup of data on both PC and Mac alongside backup from iOS and Android devices, provided they've got the Seagate app installed. There's a little bonus for Mac users too – though this drive comes NTFS formatted, Seagate's included a Mac NTFS driver that'll let OS X users write to it. And when it comes to speed, it outpaced the WD drive in most of our tests (if only by a couple of percentage points at times). While Seagate's offering isn't quite as flexible or imposingly built as the WD, it still offers heaps of storage at near-flash speeds in a relatively compact footprint – and does so at a fair price. ■ Dan Gardiner

Verdict

Exceedingly fast, compact and fairly priced. Just about everything you could want in a portable drive.



ASRock

9-Series

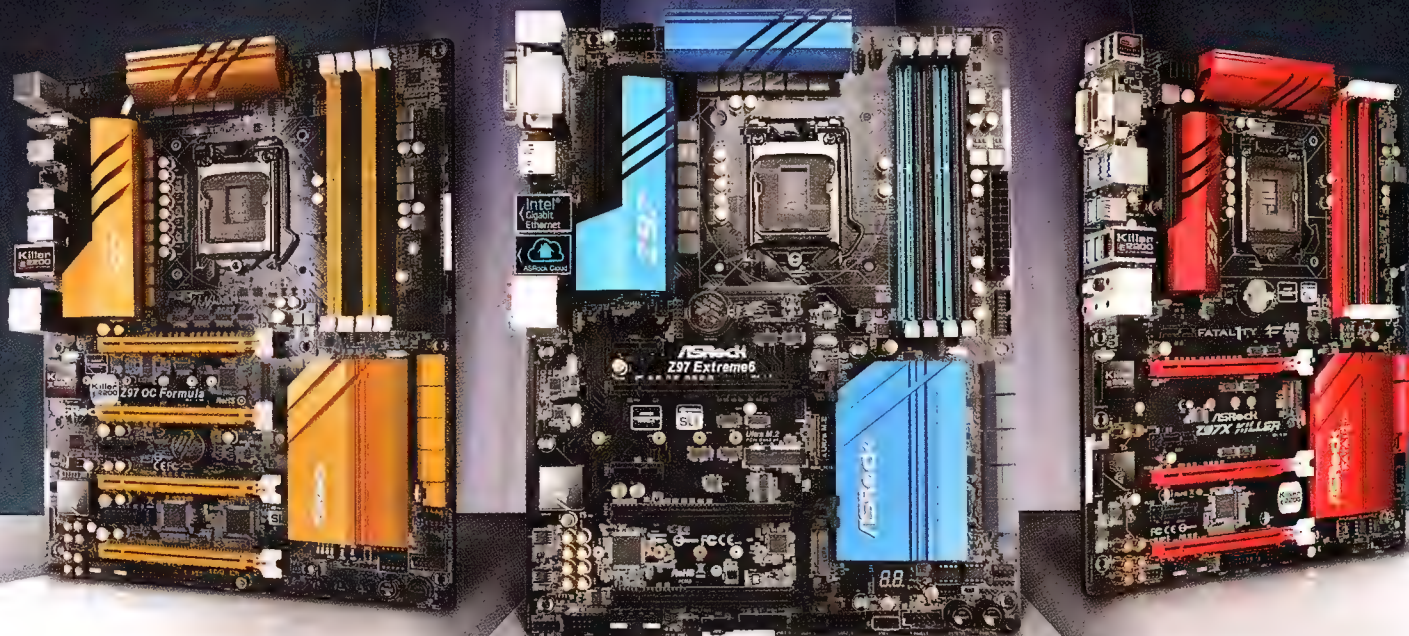
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Motherboard

Stable and Reliable



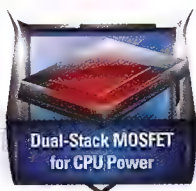
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SSDs

A SOLID STATE OF STORAGE

The first genuinely new SSDs of the year break cover and go head to head.

While we wait for PCIe-based consumer SSDs, some of the big players in the 2.5-inch format are trying to eke out every last drop from the SATA 6Gbps interface.

Crucial has launched the M550 family, whose flagship has risen in capacity from the 960GB of the M500 range up to a full 1TB model.

Intel, the grand old dame of the SSD world, has a new – well, kind of new (more on that later) – consumer range. The SSD 730 series is the first to feature home-grown Intel silicon in the controller for some time.

TAKING CONTROL

The Intel SSD 730 range is available in two capacities: 240GB (with 550/270MB/s reads/writes) and 480GB. It also features Intel's first 6Gbps controller.

This eight-channel controller, a PC29AS21CA0, is used in the enterprise-based DC S3500 drive. The SSD 730 is basically a mildly tweaked version of it.

Even the weird mix of NAND is consistent. Instead of the usual 16 identical 20nm NAND chips, the SSD 730 has 14 32GB chips, one 64GB chip and one 16GB chip, giving a total capacity of 528GB.

It's sold as a 480GB drive, as that extra capacity is used for maintenance through wear-levelling, bad block replacement and so on. It should mean great things for its longevity.

OVERCLOCKED AT LAST

Under the skin is where the fun begins. For the SSD 730, Intel has overclocked the controller from 400MHz in the DC S3500 to a heady 600MHz. The NAND bus has

also had a mild 18MHz boost to now run at 100MHz. Intel backs the range with a five-year warranty.

The elephant in the room for the SSD 730 is its power design. As an enterprise drive, there's no support for a low-power state, so even at idle the drive is consuming 1.5W. Under load conditions, this rises to 5W and above.

In performance terms it does well, especially when dealing with large files or deep I/O queue depths. Its enterprise origins also deliver serious storage.

The major benefit is a class-leading 70GB/day write endurance, but the power design needs work if Intel wants mobile users to take an interest.

BUT CRUCIALLY...

Crucial's M500 range was one of the SSD success stories of 2013. It introduced

Verdict

Intel SSD 730
480GB

\$600 | WWW.INTEL.COM.AU

Features ★★★★★
Performance ★★★★★
Value ★★★★★

The overall performance advantage and reliability of the SSD 730 is almost enough to justify the extra \$150 over the Crucial.



CRUCIAL M550
512GB

\$449 | WWW.CRUCIAL.COM

Features ★★★★★
Performance ★★★★★
Value ★★★★★

Without a side-by-side comparison it would be hard to tell the performance difference, The M550 makes a great value proposition.



very competitive pricing, and its 960GB drive was the first near-1TB SSD made for the consumer segment.

Samsung later outdid that with the brilliant 1TB 840 EVO drive, but even today the Crucial SSD has the better price.

There has been a real growth in different formats for SSD drives alongside the standard 2.5-inch, enabling them to fit within smaller and smaller devices. Crucial has responded to this, and the M550 series is available in all three favourite formats of the moment: 2.5-inch, mSATA and M.2 (type 2280). The 1TB model is only available in 2.5-inch, but the 128GB, 256GB and 512GB drives are available in all three formats.

Once again, Crucial has thrown down the gauntlet. This 512GB model is just \$449 on the street.

SOLID SPEEDS

Crucial quotes sequential read/write performance figures for the 512GB drive at 550MB/s and 500MB/s, respectively.

The 512GB M550 uses Micron's 128Gb die and 20nm MLC NAND. Opening the drive reveals eight of these chips per side of the PCB. The M550 also uses Micron's RAIN (Redundant Array of Independent NAND) to keep everything in order.

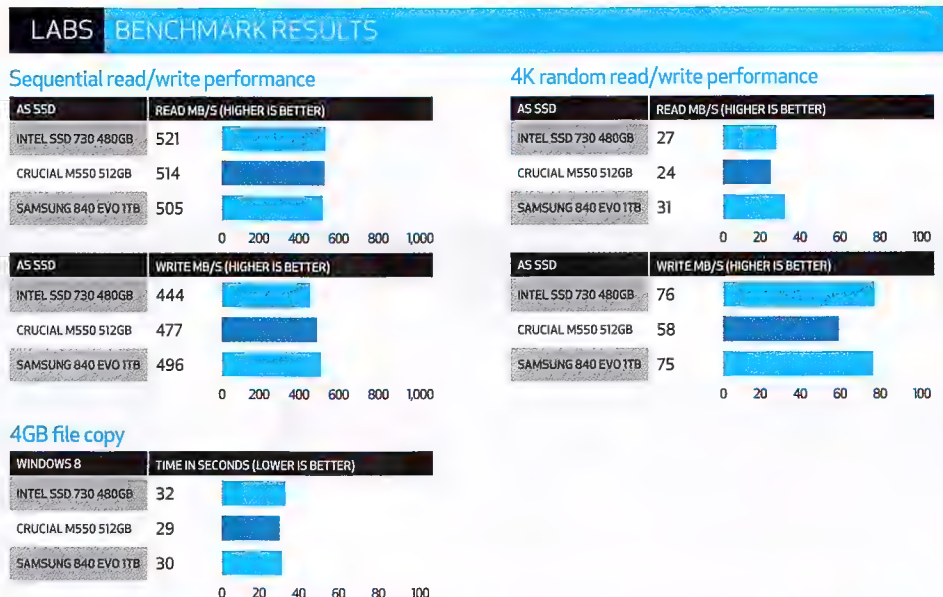
At the heart of it all lies a Marvell 88SS9189 eight-channel controller, which features AES 256-bit hardware, TCG Opal 2.0 and IEEE-1667 encryption support. The TCG Opal 2.0 support allows for the use of third-party encryption tools for more secure data storage. Together with the IEEE-1667 support, this means the drives are compatible with Microsoft's eDrive. The M550 comes with both adaptive thermal management and power protection. The former reduces the drive's performance should it get too hot, while the latter allows it to write out data that's stored in the cache should the system suffer power failure.

The M550 range includes 512GB and 1TB models. Crucial's prices are also pitched to make the competition take notice – the street price of the 1TB drive, for instance, works out at just 88c/GB. Even 18 months ago, that would have seemed highly unlikely.

HEAD TO HEAD

So both drives contain new enterprise-descended hardware and offer generous capacities at decent price points, but how do they stack up against each other in terms of actual performance?

Sadly, the results weren't as good as expected, with both drives scoring a little under their quoted sequential read/write speeds. Intel quotes read/write figures for the SSD 730 of 550MB/s and 470MB/s, respectively. We couldn't quite reach those speeds with the ATTO



"Both drives contain new enterprise-descended hardware and offer generous capacities at decent price points."

benchmark, which gave us 529MB/s and 454MB/s.

The Crucial drive was more in the ballpark of the quoted scores, with 542MB/s for reads, and the 512MB/s write performance slightly better than predicted.

The older 1TB Samsung 840 EVO still beats both new drives, with speeds of 555MB/s for reads and 519MB/s for writes.

Neither Intel's controller nor the Marvell one used by the Crucial M550 care about whether the data is compressed. Both produced read/write scores in AS SSD's compressible data test that were comparable to the scores in its incompressible benchmark.

AS SSD's 4K random read/write tests are a better indication of how the drive will behave when dealing with the small files of everyday use. The Intel drive's write performance is up there with that of the awesome Samsung 840 EVO drive, producing a score of 75.90MB/s, compared to the 75.56MB/s of the EVO in the 4K random write test. Crucial's 512GB M550 is notably behind both, achieving a throughput of 57.51MB/s.

GET REAL

For this review we spent a lot of time using real scenarios: copying a large 4GB image, a 17GB Blu-ray image, a 50GB folder of small files and a 60GB Steam folder, and using WinZip and WinRAR to compress and decompress the Steam folder. We took the 4GB image and timed it loading into Photoshop, re-rendering from 300dpi to 600dpi and then saving the resulting 16GB file to disk. Using TeraCopy, we also timed how long it took to copy a folder.

Copying a 4GB image took 32s (120MB/s) with the SSD 730, but the M550 was slightly faster at 29s (129MB/s). Next up we copied a large, single 17GB Blu-ray file, and once again the M550 showed a small edge. It managed to copy the file in 2:18m (126MB/s) compared to the 2:25m (120MB/s) of the SSD 730.

We then tested the copy speed of a 50GB folder containing over 28,000 small files and a 60GB Steam folder containing nearly 30,000. Here the small advantage swung back in Intel's favour: 9:15m (78MB/s) as opposed to the

10:05m (72MB/s) of the M550. For the 60GB folder we saw Intel take the lead again, with 14:12m (80MB/s) versus 15:48m (72MB/s) when copying the files.

So the synthetic results are borne out by the real-world tests. The new Intel drive is pretty capable when it comes to copying large files, but the sequential advantage of the Crucial SSD gives it the edge there. When it comes to general OS usage and copying folders with lots of small files, the Intel drive shows a distinct lead. In terms of straight performance, we'd side with the Intel drive. Its record for stability and longevity from the enterprise segment means it's likely to be a very reliable drive, too.

The problem is the price tag. The Crucial 512GB M550 is \$150 cheaper, and that nets you a marginally higher capacity. It's slightly off the pace, but in the real world, Intel's slight advantage is harder to accept in the face of the related cost. If you want sheer performance then the Intel is your drive; if you're on a budget, it's the Crucial. Both are excellent high-end SSDs. ■ Simon Crisp



GAMING MOUSE

\$85 | WWW.MIONIX.NET

MIONIX AVIOR 7000

A great choice for lefties.

Lefties, don't despair – the gaming world hasn't forgotten you. The Avior 7000 mouse uses a symmetrical, ambidextrous shape with thumb buttons on both sides. That gives it nine buttons in total, which is more than most.

However, a design like this is always going to involve compromises. A lower stance means it can't quite compete with the comfort of some other mice, while the side buttons opposite your thumb are all too easy to press unintentionally.

Still, in every other respect it performs admirably. Its 7,000dpi sensor is unfazed by suboptimal surfaces, thanks to SQAT: the Surface Quality Analyzer Tool. Silly name, but it's a nifty feature that optimises tracking fluidity to suit your desk. Factor in the blazing 215 inches per second tracking speed, 32MHz internal processor and 1,000Hz polling rate, and you can't blame the

mouse if you don't keep up with the gaming action.

Mionix has ditched fancy design frills in favour of quality components, so in addition to that potent processor, you also get top-notch switches with a 20-million click lifespan, plus a durable four-layer, soft-touch outer coating. This attention to detail extends to the accompanying software, which is a close match for the comprehensiveness and control of our current favourite, the Roccat Kone Pure. Ultimately, the compromised ergonomics mean this mouse misses out on full marks, but if you're of the left-leaning persuasion or prioritise top-end tech, look no further. ■

Verdict

The ambidextrous design and reasonable price make this a fast, high-end mouse for everyone.



GAMING HEADSET

\$310 | WWW.ROCCAT.ORG

ROCCAT KAVE XTD 5.1

5.1 gaming audio; now with bonus chained-to-your-desk feeling.

I still have terrible nightmares about the abomination that is the Turtle Beach EarForce XP Seven, and ever since have approached headsets featuring complicated base stations somewhat gingerly. The excellent Plantronics RIG went a long way to healing those wounds; and now with the Kave XTD, I'm close to a decent sleep.

Now the only thing keeping me up is the viability of multi-driver headsets. Packed inside each of the Kave's almost comically huge cans are three drivers – two traditional 40mm units and one 30mm vibration unit – each angled at 12° which, so Roccat claims, accurately matches the ear's natural form. Out in the field, however, it's tough to justify the engineering (and price tag); sure, the *Matrix* lobby scene came at me from all sides, and pinpointing noise sources was fantastic during *BF4* and *Titanfall* testing, but the difference

isn't staggering compared to single driver units.

What was a little fun, regardless of how gimmicky, was the vibration drivers. They're like tiny Xbox rumblers for your head. What impressed most however, is the Kave's base station. It features its own inbuilt multi-channel soundcard (goodbye annoying hardware buzz) as well as Smart Link which (like the Plantronics RIG but wireless) connects with your smartphone so you can still take calls without pausing your game.

What the Kave lacks is versatility. It's a fixed-line, PC-only USB headset with no quick-release system or auxilliary input option. And it's really expensive.

■ Troy Coleman

Verdict

A precise and powerful audio solution but it lacks versatility, portability and reasonable pricing.





LASER GAMING MOUSE

\$90 | WWW.GAMDIAS.COM

GAMDIAS ZEUS MOUSE

A niche mouse that shows potential.

Gamdias is a relatively new name in gaming peripherals, but it's quickly shown that it aims to stand out by innovating and trying new things.

The Zeus uses gear wheels on the base so you can adjust the position of the plastic fins of the body – effectively letting you tweak the width to suit. It's a novel idea that works well – although this is already a large mouse, so many gamers will likely be happy with the default positions. This design also necessitates gaps in the chassis, which means you have to be careful to avoid your fingers slipping inside it. Physically it's quite long and a little heavy (even without the weights) and hugs the surface it's sitting on quite closely. This is a mouse for MMO players, not twitchy FPS players. The sharply-angled drop off at the back makes for a natural spot to rest your palm, though shorter-fingered folk may have trouble reaching the scroll wheel from this

position. Gamdias' driver and configuration control panel is a one-stop shop for configuring any Gamdias gear you have plugged in. For the Zeus, that includes excellent macro-creation – there's even the ability to simulate a pixel-accurate click to a specific spot on the screen (great for automating tasks that require both mouse and button presses), control over sensitivity changes, lighting and even a stats page with details on your mouse use. This isn't revolutionary – and it's quite niche – but it is encouraging to see a peripheral-maker who's willing to try new things in an effort to find something that, perhaps one of these days, might be a game changer.

■ Dan Gardiner

Verdict

It's based on an interesting idea, but the size and design may limit the appeal.



MECHANICAL GAMING KEYBOARD

\$139 | WWW.TESOROTEC.COM

TESORO DURANDAL ULTIMATE GN1

Full-featured at a lower price.

The beauty of making the shift to a mechanical keyboard is that, depending on which colour Cherry switch you go for, you essentially know what your key-performance will be, which means deciding where to drop your hard earned cash is narrowed down to the board's additional features, build quality, support, and – above all – price. The Durandal Ultimate ticks almost every box.

The list of features the USB Durandal boasts is as comprehensive as most of the heavy-hitters in the market today. Running through the basics there's full N-key rollover, a gaming mode (which disables the Windows key), 128k onboard memory which stores up to 5 user profiles as well as macro key info, multi-stage backlighting, audio/mic ports, multimedia keys and a couple of USB 2.0 ports on the upper flank. Measuring in at 455 x 206mm with the optional

faux-checkerplate palm rest attached, it's by no means demanding on space, especially considering you're getting an extended keyset.

Our review unit was fitted with the nice and quiet (in comparison) Cherry Brown switches, but Red and Blue models are also available if you prefer something a little snappier, though you may have to do a little digging to find them.

We would prefer to see USB 3.0 become the standard for through-ports, and the software interface could be a little slicker, but for a mechanical gaming keyboard in this price-bracket, there's not a lot more you could ask for.

■ Troy Coleman

Verdict

A full-featured mechanical gaming keyboard that isn't going to cost you an arm and a leg.





INKJET PRINTER

\$59 | WWW.HP.COM.AU

HP DESKJET 2540

Can this low-cost printer deliver a high-quality performance?

This inkjet all-in-one printer has a better feature range than you might expect.

Models selling at this price are usually restricted to USB connectivity, but the Deskjet 2540 also has Wi-Fi networking and supports Wireless Direct Printing. It's even AirPrint-compatible.

But there are compromises. It only has two ink tanks; a black, and a tri-colour cartridge with cyan, magenta and yellow inks. On-printer controls are basic, the screen is a 2 x 4cm LCD and there are no facilities for printing from removable media, such as SD cards or USB sticks. Paper handling is basic too, with no auto duplex or borderless printing.

Output quality could best be described as 'good enough'. It can't match the best printers in HP's Officejet or Photosmart ranges, but for the price you wouldn't expect it to, and it certainly doesn't disgrace itself. Text printing is vivid

and stands out well, but lacks the precision of the best-in-class inkjets. Photos on quality photo paper were well realised, with colours accurately reproduced (if a little subdued) and sharp details. Plain paper image prints weren't as good, showing signs of banding and speckling. It isn't built for speed either, taking three-and-a-half minutes to print our 20-page text-only test document.

For all our criticisms, it's wise to remember exactly who this printer is aimed at. It isn't for photography enthusiasts, office printing or high-needs users. It's for those who only need to print occasionally, and it's great for the price.

■ Ian Osborne

Verdict

Great for those with low needs, but it can't match pricier models for quality or feature range.



A3 INKJET PRINTER

\$170 | WWW.CANON.COM.AU

CANON PIXMA iX6860

It prints in A3, but can this machine replace your workhorse printer?

This new Canon A3 inkjet probably isn't ideal as a sole home printer. It

lacks duplex, has no internal paper tray and is not an all-in-one, so you can't photocopy or scan. It doesn't have a screen or USB/memory card facilities to print from external media either. It has good mobile options, though, with AirPrint and Google Cloud Print catered for, and apps available for iOS devices.

As a text printer, it's not quite as vivid as an office-orientated machine, but it doesn't disappoint. It's speedy too, printing a 20-page, A4 text-only document in under two minutes.

But naturally, it's the image quality that's of interest here. Printing an A3 flyer, the results were excellent; text was clear and well defined, colours were accurate and there was little speckling and no banding. A photo test image was less impressive.

The colours were good, but it showed signs of banding, especially on the colour ramps.

However, the printer really shone with high-quality prints on photo paper. Definition was superb and speeds were reasonable, too.

Despite a few compromises, the Canon PIXMA iX6860 excels at the tasks it's intended for. It's probably not ideal as your only printer, but it would make a great secondary device to power up whenever you need to print quality photos or in A3. ■ Ian Osborne

Verdict

This is not an ideal all-round printer, but it's great for large-format and photo printing.



BREAK AWAY FROM SATA BOTTLENECKS

and free up your system's bandwidth



OCZ PCI Express Revodrive 350 SSDs break the bottleneck and deliver up to 3X the performance of a SATA-based solution. A potent combination of a quad-controller design and the latest generation of flash, Revodrive 350 empowers gamers, media professionals, and workstation users with the speed and responsiveness your applications demand. Unleash your system's true potential and get RAID performance without the hassle.

Bootable PCIe Gen. 2 x8 | Up to 1800MB/s | Up to 140,000 IOPS | Available in 240GB – 960GB



A discrete audio card equivalent solution ensures irresistible hearing experience.

ROG LANGuard redefines the meaning of non-interrupted stable networking.

For more information on ASUS's Z97 series motherboards, scan in the QR code below on your smartphone or tablet, or visit www.asus.com/Microsite/mb/9series.



ADVERTISING FEATURE

ASUS's exclusive Z97 innovations

Inspired by users, designed for users.

As the latest motherboard chipset from Intel, the new Z97 updates last year's Z87 and adds support for upcoming Haswell and Broadwell CPUs. Using the new technology, ASUS has put its smartest engineers to work on developing a range of motherboards with cutting edge features. From number crunchers to gamers, ASUS hardware gives you the best performance while maintaining cool and quiet efficiency. With 12 new Z97 boards, this detailed guide will help you understand the latest features so you can choose which model is right for your next build. From auto overclocking to impressive audio, we break down and explain what makes ASUS's 9-series motherboards special.

TUNE IN

ASUS has given its BIOS a total remodel to give an intuitive graphical

interface that can be navigated with your mouse instead of a keyboard. With Ezy and Advanced modes, the ASUS BIOS ensures users of every level can get the most from their PC.

EZ TUNING WIZARD

Not everyone wants to manually adjust settings to get the fastest stable performance for your application. ASUS has built an intelligent OC wizard that does it for you. It knows what CPU and RAM you have connected and asks you some questions to determine what you use the system for and what sort of cooling you have before applying tweaks. If you run water cooling, the system will push your CPU even further to ensure the best possible performance without compromising stability. The ASUS Wizard is a truly effortless way to conduct system tuning.

5-WAY OPTIMISATION

BIOS tuning is important, but ASUS also has a powerful Windows software package that can

give total system optimisation in one click. You can automatically overclock your hardware with TurboAPP, as well as customising network and audio setting. TurboAPP lets you create profiles for different tasks, so your PC is automatically optimised whether you are working, gaming or surfing the net. FanXpert 3 lets you optimise your fan speeds thanks to the support of PWM/DC control, or even PWM+DC control, as well as the multiple onboard thermal sensors and the flexibility to utilize different reference temperature settings – keeping your PC cool yet extremely quiet. In the background the board is also managing power use to give rock solid power delivery and maintain efficiency.

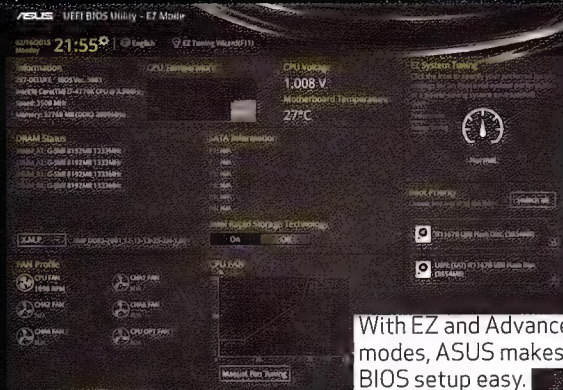
RAMDISK

Putting your unused system RAM to work, RAMDisk lets you further improve PC performance. While your SSD may be blazingly fast, your system RAM is even faster. Working as a buffer with your existing drive, it

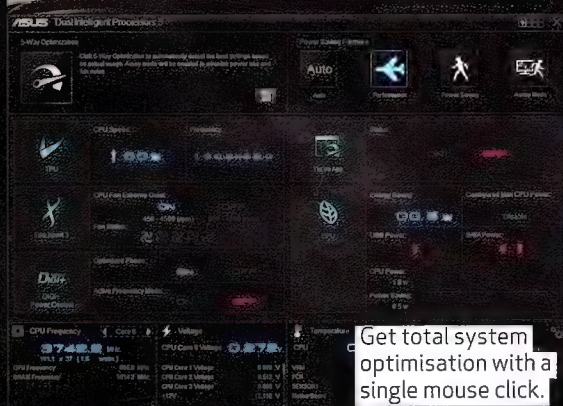
can speed up performance while reducing write cycles – prolonging the life of your SSD. Better yet, setup is super simple and RAMDisk can dynamically manage DRAM use for you.

COOL RUNNINGS

The TUF Z97 boards take a unique yet comprehensive approach to system cooling. Dust de-Fan is a cooling management system that can spin fans in both directions, helping to dislodge any dust that would otherwise build up in critical areas. This can be set to happen automatically, or during set periods such as boot up and helps keep your system running cool. The ASUS TUF ICE processor gives precision control over fan speeds without affecting CPU load, or even DCP latency thanks to being a completely hardware based solution. With extra fan headers and up to 12 reference temperatures to react to, you can take control of all your fans through one easy to use system. With the Thermal Radar 2 software and a compatible ASUS



With EZ and Advanced modes, ASUS makes BIOS setup easy.



Get total system optimisation with a single mouse click.



Get Qi Charging and NFC Express 2 on the ASUS Z97 DELUXE.



Dust de-Fan automatically reverses your fans periodically to expel dust build up.

graphics card, you can even take control of your GPU cooling system.

GET CONNECTED

Even the most powerful PC can be crippled by a network connectivity bottleneck, so ASUS has developed tech to ensure a top quality Ethernet connection. No matter if you are gaming or just browsing the net, keeping those network packets in order is top priority. On the ASUS and TUF motherboards, TurboLAN intelligently monitors and optimises your network settings for each application. On ROG motherboards, the latest GameFirst III software works with your Intel LAN chipset and pre-set modes, where the UDP based gaming traffic will be prioritised over other activity, such as background downloads. You can also use the built in tools to monitor your network as well as test your connection to weed out any issues.

ASUS ROG boards don't skimp on hardware either featuring LANGuard, a collection of advanced signal

coupling technologies, premium surface mounted capacitors and superior electrostatic and surge protection that ensures optimal network performance at all times. Connectivity isn't limited to Ethernet either – selected models have high speed 802.11ac Wi-Fi.

IMPRESSIVE AUDIO

ASUS's Z97 motherboards include comprehensive discrete audio card solutions for clarity and immersive gaming and media playback. Across the range you get isolated, linearly-powered USB 2.0 ports to make sure any effect from a varying +5V voltage is minimized; perfect for the audio enthusiast desiring the purest audio output from their USB DAC. You also get an integrated audio amplifier designed to drive high end headsets, a de-pop circuit for quiet power on and off and premium hi-fi audio capacitors for a warmer sound. ASUS even goes so far as to have a separate reference ground for the audio components on

the sound card as well as a stainless steel EMI shield on the audio chips (on select models) to ensure nothing mars your experience.

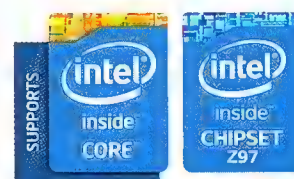
On select ASUS and TUF motherboards, the audio amplifier will detect output devices plugged into the ports, so it knows when you've inserted headphones and will automatically switch to the audio jacks.

On the high end ROG motherboards, Sonic Sense Amp automatically detects and calibrates to the impedance of headphones connected to the front headphone jack, to ensure you get the best result with your headset. The Sonic Sound Stage is a fully hardware based Equalizer that works well under all OS's and popular gaming genres while the Sonic Studio further enhances your audio source to suit different applications, such as improving vocal clarity.

YOUR DIGITAL LIFESTYLE

ASUS motherboards are not just about speed – they also include a range of features

that integrate into your digital life. They are ideally set up to connect to your ASUS powered network and provide the most convenient media streaming experience. If you go the deluxe route, you can also get a Qi compatible wireless charging device with NFC Express 2 – so you can bring video streaming on the go with a simple tap. Compatible ASUS boards also have a host of next-gen storage interfaces. With SATA Express, you know your next computer is totally future proof and can handle the latest high speed storage devices. You can also use a mobility M.2 SSD, so you can set up your system how you want.



ASUS 9-SERIES MOTHERBOARDS SUPPORT THE LATEST 4TH AND UPCOMING 5TH GENERATION INTEL® CORE™ PROCESSORS.

software

» APPS FOR ALL THE PLATFORMS EDITED BY PETER DOCKRILL

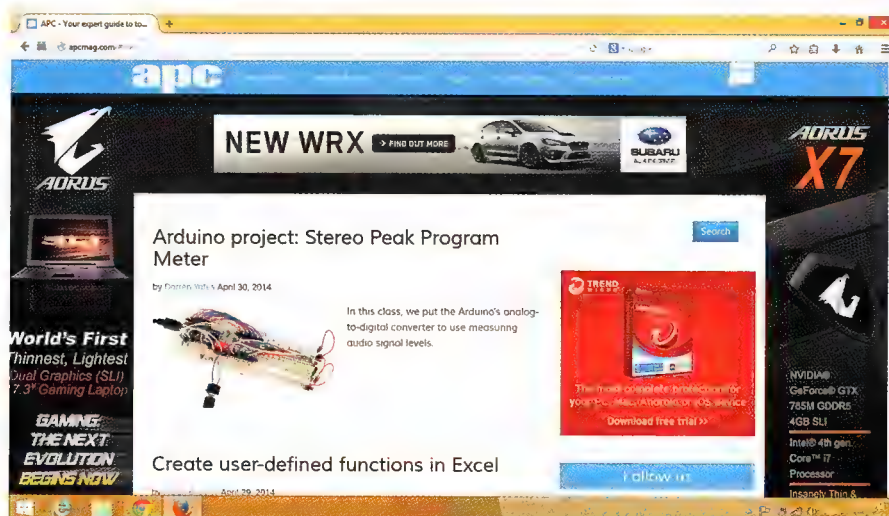


Windows SOFTWARE

Mozilla Firefox 29

The world's pioneering 'alternative' browser is back with a fresh look and feel.

FREE | MOZILLA | WWW.MOZILLA.ORG



Google

Search

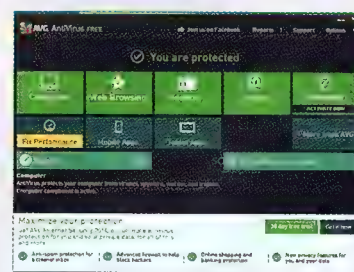
Mozilla Firefox is free and open source software from the non-profit Mozilla Foundation. Know your rights.



It's been nearly 10 years since Mozilla launched Firefox, and while Chrome's rampant growth and feature additions in recent years may have been making most of the browser headlines,

Firefox still has a huge, loyal user base, and Firefox 29 is a major revamp: the culmination of its 'Australis' redesign, said to be two years in the making and incorporating hundreds of new features and under-the-hood tweaks. Take the after-install tour and the first thing you'll notice is a more-than-passing resemblance to Chrome's aesthetic (it's almost cheeky, really – especially the identical icon and placement of the menu/settings button), but Firefox's broad ability to

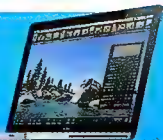
customise its UI sets it apart from Google's largely static panel. New features include convenient one-click bookmarking, a zillion ways to personalise on-screen buttons and fields (some by simply drag-and-drop) and a renewed emphasis on Firefox Sync, enabling cloud syncing of bookmarks, history and passwords between devices via Firefox Accounts. One feature we particularly like is the way Firefox de-emphasises the appearance of any background tabs – they're still visible but become transparent, helping you focus on your current tab. If you've moved away from Firefox in recent times, have a gander at Firefox 29 – it might just pack enough to lure you back.



AVG AntiVirus

FREE | AVG | WWW.AVGFREE.COM.AU

In light of Microsoft's recent cut-off of support and updates for XP, users still running the decidedly long-in-the-tooth OS have some difficult questions facing them. While, for security's sake, we'd strongly advise readers to upgrade to a newer, more secure and still-supported OS, it's inevitable that many XP users will persevere with their current setup despite Microsoft's (and our) nagging admonitions! To those users, we'd say the need for a robust security suite is more crucial than ever. If you're a Windows XP user and you didn't already have Microsoft's well-regarded Security Essentials software pre-installed, we have some bad news for you. The company is no longer offering it for download to XP users. (If you do have it installed, however, Microsoft says it will continue receiving updates until April 2015.) XP users who don't have a commercial antivirus program protecting their PC might be advised to consider a free alternative, such as AVG's. The free AVG option doesn't include a number of features in the company's commercial product – including spam blocking, file encryption and shopping protection among others – but it's the bare minimum of antivirus protection you should be running in lieu of Microsoft's cancelled support. Bear in mind, however, while AVG has pledged to continue supporting AVG FREE for XP users, the company nonetheless is on record as recommending its users to upgrade from XP. The ancient OS can only be fortified for so long, folks!



Mac » OS X APPS

Screens 3

Control your Mac from any device with an internet connection.

\$43.99 | EDOVIA | EDOVIA.COM

Screens is a VNC app that allows you to control your Mac from just about any device, including iOS, over any network connection. Screens 3 is an update, but one that required a complete rewrite of the previous version, so by any measure it's a new application.

Controlling a computer from afar is nothing new, but the best VNC applications let you access devices quickly too. Here, Screens 3 is already up to speed; our local network machines were recognised as soon as the software was installed on one MacBook. From then on it was just a case of entering the username and passwords to take control.

As with all screen-sharing tools, the speed of your connection is key. Over a local network you're fine, but on a slower connection things can get a bit juddery. However, the fact that you can still access your stuff on a Mac from an iPhone with a dodgy 3G connection when you're halfway up a hill on a rainy day should temper any disappointment with less-than-ideal screen rendering. Screens isn't perfect, but

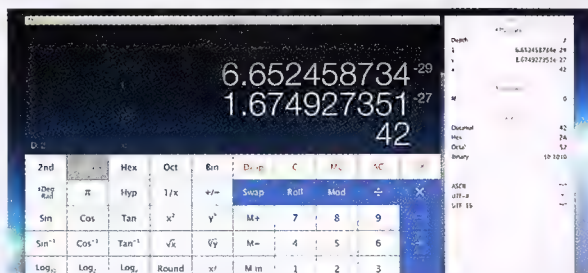


it's usually good enough.

Some might balk at the price tag of \$44 for the Mac version and \$25 for the iOS client, but then this sort of application does rely upon you having more than just a one-off need for it. If you often need to control a Mac remotely, the price shouldn't bother you.

Screens 3 is a refined product that's well designed and works well in exactly the areas you need it to. If you're looking for a good way to connect to your home Mac it's an excellent tool. It works quickly, and offers a good level of options and tools without going overboard and increasing the overall complexity of the application.

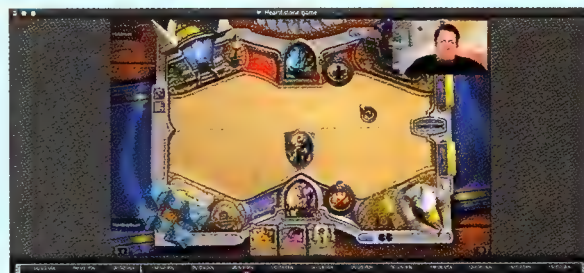
■ Christopher Brennan



PCalc 4

\$12.99 | TLA SYSTEMS LTD | PCALC.COM

Since 1992, Mac veteran PCalc has provided a 'pro' calculator to Apple's basic equivalent. With this latest release, however, there's a radical change in the OS X app, which is now based on its iOS cousin. But don't fear that OS X apps are dumbing down to match iOS counterparts. PCalc remains a high-end, fully featured scientific calculator, but the rewrite brings useful features from the iPad and iPhone. There are multiple lines on the main display, and an optional ticker tape beneath, showing recent calculations. Improvements and enhancements have been made to editable functions, conversions and themes, and a ton of layouts are included. Of course, PCalc remains a digital take on desktop calculator — there's no tiptoeing towards sort-of-spreadsheet Souolver — but for anyone wanting such an app, it's perfect. ■ Craig Grannell



iShowU Studio

US\$90 | SHINYWHITEBOX | SHINYWHITEBOX.COM

This app captures your screen as a 'screencast', and adds footage, annotations, and soundtracks. You can then export the video to a file or YouTube or Vimeo. Recording footage is easy. You can also select a mic and camera to record a voiceover and a second stream of video. Editing is easy too. You can easily trim the beginning and end, cut, copy and paste elements, and add in additional footage. The interface is easy to get to grips with, especially if you're already familiar with video-editing tools like iMovie. There are plenty of tools for annotating your video with captions, shapes for highlighting specific areas, and the ability to pan and zoom around your screencast. You can also freeze frames, and correct colour. iShowU Studio is simple enough for a novice, but all the power-user tools are here too, making it a great option for more demanding too. ■ Ian Betteridge



App Store » iOS APPS

Heyday

Making every day memorable.

FREE | HEY, INC | TINYURL.COM/MABGCN4

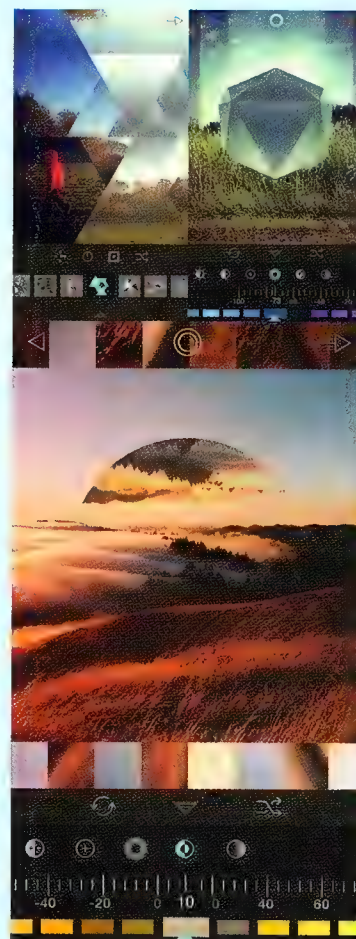
H The App Store is home to plenty of digital journal tools, but all of them require effort from the author to be useful. Heyday solves this problem in a very elegant way — and one that actually makes us want to participate. The free app converts existing photo libraries from an iOS device into an automatic journal of your life, complete with geolocation data and time stamps. The speed and accuracy at which Heyday accomplishes this task is nothing short of amazing. On days when photos aren't taken, the app continues to work in the background with minimal battery impact, capturing key places visited.

The app creates events with details of when and where they happened, grouping photos into collage layouts (from 50-plus available choices), each with one of 18 automatic Instagram-style filters. Images can be added, changed, moved between events, or removed entirely in just a few taps. Heyday optionally sends a daily push notification to remind you of past events that took place on the same day, with a pop-up calendar for easy browsing.

The trip down memory lane became great morning fun for this reviewer's



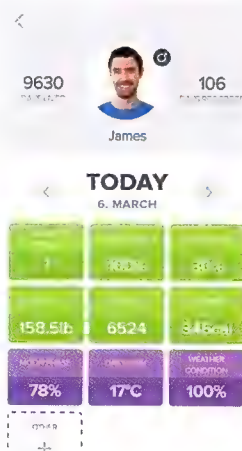
family, while slyly encouraging us to spend a few moments fleshing out older entries by adding captions or tagging Facebook friends. Still, a few issues persist, notably the fact that Mac and native iPad versions don't exist, despite the inclusion of a cloud-sync option. And photos aren't synced to the cloud, which means deleting one from Camera Roll also removes it from Heyday.



Fragment

\$2.49 | PIXITE | FRAGMENTAPP.COM/

Fragment produces effects that nothing else in the App Store even attempts to mimic, yet remains exceedingly easy to use and explore. You can choose from one of 46 built-in base effects, which are essentially distortion masks based on a variety of shape combinations — from simple frames to abstract designs, including crystal shards, geometric patterns, and circular constructs. You can zoom and rotate the distorted image in real time, which adds a truly fun aspect to the process of discovering cool visual combinations. Deeper controls are available, or you can use the shuffle feature and then tweak the results. Also, you can "refragment" and run a completed image through again with different effects, providing even more creative opportunities.



OptimizeMe

\$4.99 | OPTIMIZE ME | TINYURL.COM/K93Q7KD

OptimizeMe doesn't just keep a log of your daily activities, it also tells you how to improve them and how each one affects another, living up to its billing. The app organizes your manually inputted activities into four categories: health, creativity, routine and pleasure. Whether it's walking to work or taking a shower, you can record everything. Each activity also lets you select your mood, and while this may sound silly and superficial, it can actually lead to an insightful analysis of your day. OptimizeMe takes all of your recordings and correlates them with one another, so it can shine a light on how to improve your productivity and mood throughout the week.



Google Play » ANDROID APPS

IFTTT

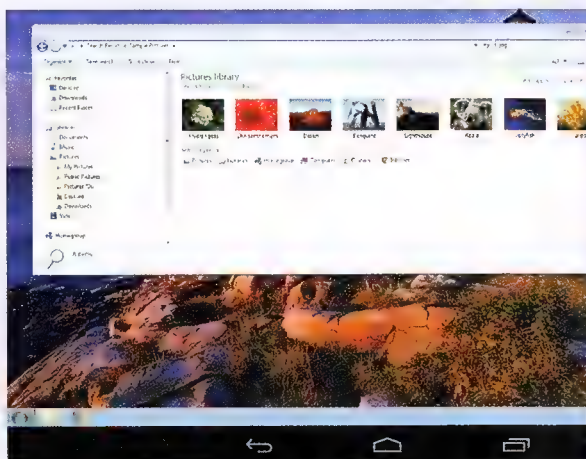
Downloading IFTTT might well be the last manual chore you perform.

FREE | IFTT | TINYURL.COM/MXQDGT0



When revolutionary productivity service IFTTT made the jump from the web to mobile nearly a year ago, a few eyebrows were raised.

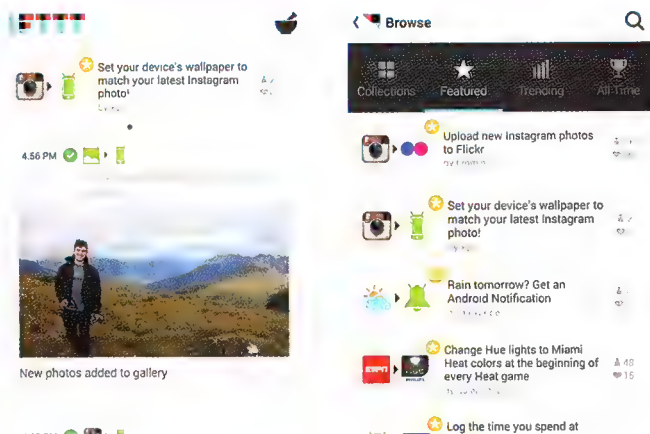
Not that IFTTT was now available for smartphones – in fact, it's a perfect fit for the mobile platform – but rather that it was an iOS exclusive, snubbing the far more versatile (and potentially IFTTT-friendly) Android operating system. In any case, IFTTT is here now, and if you're an Android user it's worth your attention. IFTTT stands for "If This, Then That": it's a task automation service that executes a particular function if a particular condition is satisfied. That description sounds a little dry until you consider the 98 popular channels that IFTTT has going for it, just begging you to include them in a roll-your-own 'recipe': services like Dropbox, Facebook, Gmail, Instagram, Twitter, WordPress and stacks more.



Chrome Remote Desktop

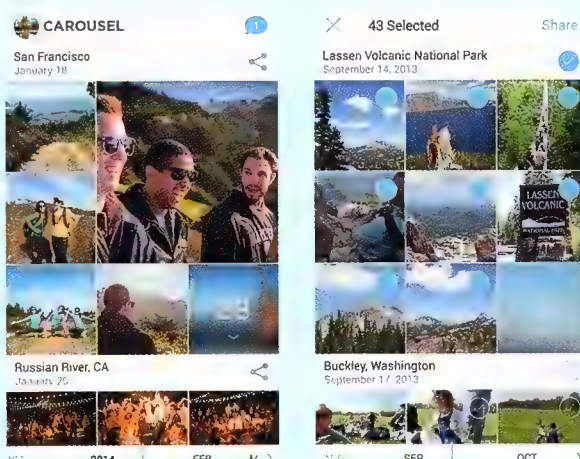
FREE | GOOGLE | TINYURL.COM/OUN2RTL

There's almost no end of PC and Mac remote control/desktop solutions for mobile devices, but the majority of them will charge you a fee for the convenience. Not so Google, which recently released Chrome Remote Desktop for Android. Setup's as simple as you could hope for: you'll require Chrome on your desktop (obviously), but all you need then is to download the host add-on from the Chrome Web Store, set up a PIN for security and you're away. We tested this on a smartphone and it was more than adequate, although we imagine the remote control experience would feel more comfortable on the larger display of a tablet. But in either case, Chrome Remote Desktop could be a life-saver if you're in a pinch at work and you need a file from your home PC (or vice versa).



IFTTT recipes, once set up, are totally automated for you, and can be things like "Save my Facebook photos to Dropbox", "Email me if new LinkedIn jobs appear", "Always set my latest Instagram as my Android wallpaper" and so on. Spend a little time dabbling with IFTTT and it's quite amazing how useful the service can become, and the new Android version, like its iPhone counterpart, unlocks six new exclusive mobile channels. On Android these are: device, location, notifications, phone call, photos and SMS.

Egads, the possibilities!



Carousel

FREE | DROPBOX | TINYURL.COM/NW5Q5W7

There's an episode of *Mad Men* where Don Draper brainstorms a marketing strategy for a slide projector, which he whimsically dubs 'the Carousel': a time machine that lets us revisit moments from the past with our loved ones. With its new Carousel app, Dropbox hasn't really changed all that much from Draper's emotional vision (they've even kept the name). Carousel is essentially a gallery app for all the photos in your device and Dropbox folder, with easy share functions. Carousel's killer feature is it automatically uploads all your images as you take them to Dropbox; this is great for users who aren't careful with backing up their photography data, but less so for people who don't want to put too much strain on their Dropbox quota...



Windows Store » WIN PHONE 8

Beamly

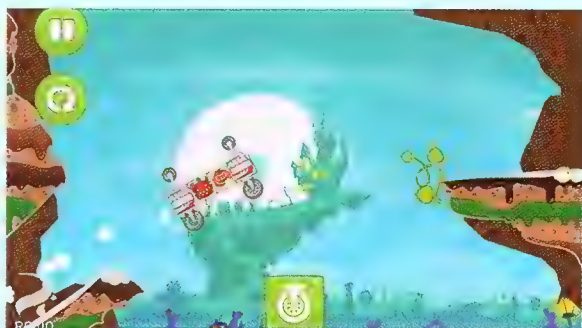
The ideal TV companion relaunches, with a few bumps in the road.

FREE | BEAMLY | TINYURL.COM/N4MF7QY



Twitter seems to be in the midst of a mid-life crisis of sorts with its user growth virtually stalling, obliging the social network to look for alternative anchors with which to safely harbour itself.

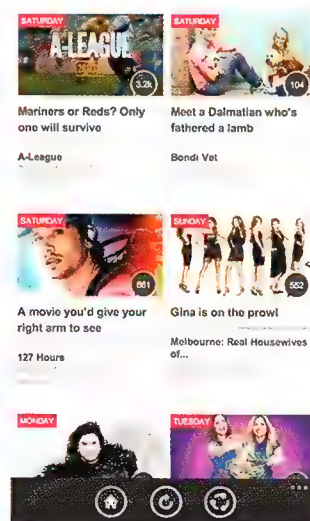
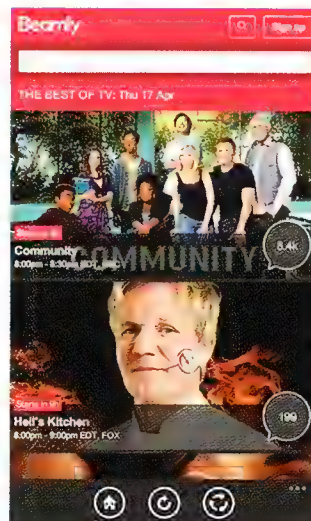
The most obvious candidate could be television, with Twitter in the process of fashioning itself as the ideal de-facto chit-chat companion for the medium, letting you converse in real-time with millions of others all watching the same programs and channels. If that's to be the case, Twitter might face some stiff competition from rival Beamly, which until very recently was known as Zeebox. While the freshly rebranded version offers the same set of functionality as its former Zeebox incarnation, the new emphasis is on Beamly's social aspirations (it now calls itself "the social network for TV"), with features like the TV guide lurking closer to the background. We've loved Zeebox in the past so were quite keen to see how Beamly played on



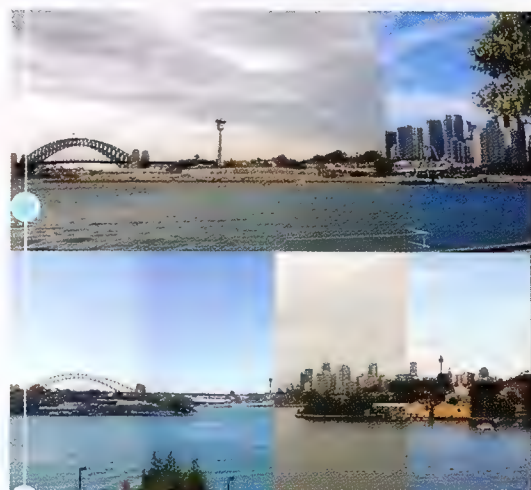
Bad Piggies

99C | ROVIO | TINYURL.COM/O52EBQG

Several months on from decisively edging out of BlackBerry as the preferred third choice for consumer smartphones, Windows Phone still has a clear problem in terms of attracting premium titles from name-brand developers. Case in point: *Bad Piggies*. This follow-up title to Rovio's smash hit *Angry Birds* originally released on iOS and Android nearly two years ago, but it's only just launched on Microsoft's smartphone platform. Still, better late than never. In *Bad Piggies* you're cast as the bad guys, charged with ferrying the pigs to their objective by assembling and piloting vehicles to transport the lazy sods. It's a physics puzzler like its predecessor, but whereas *Angry Birds* offered an instantaneous pick-up-and-play experience, *Bad Piggies* is more of a slow burner, requiring careful consideration of how to create the perfect pig-carrying contraption. Recommended.



Windows Phone, but the current app seems to be a bit of a work in progress. Some features, like the indispensable TV guide, haven't been ported into the WP8 release yet, while others — like the rather crucial log-in button — weren't working when we tested them. It's a shame, because when the app is fully up and running it's the closest thing to an ideal TV companion we've ever seen. Here's hoping Beamly's developers iron out the wrinkles in short order.



Project Tripod

FREE | PROJECT TRIPOD | TINYURL.COM/LP8EOLH

Armed with cameras in our smartphones that go everywhere we do, people are taking more photographs today than at any point in history, and yet we're only starting to take advantage of the creative opportunities offered by this massive, potentially communal data set. Project Tripod is a good example of the possibilities. By taking a photo from a certain spot, you create a 'virtual tripod' that others can later add to, with the magic of location and visual alignment software theoretically showing changes over time. Great idea, but it will only take off if enough budding photographers get behind it. ■



Rating of 90 from Tweak Town



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FIND THE PERFECT TABLET
FOR ANY NEED!

TOP TABLETS ON TEST

THEY'RE RAPIDLY REPLACING PCS & NOTEBOOKS, BUT
DARREN YATES FINDS SOME SURPRISES IN THIS
ROUNDUP OF 14 iOS, ANDROID & WINDOWS TABLETS.

Can you believe it's been four years since Steve Jobs held aloft the first iPad? What started out as an unknown quantity has since changed the face of computing – traditional PC rivals left clutching thin air; new, more nimble players filling the boom in demand for all things touchscreen. It's no coincidence names like Apple and Samsung are mentioned in a similar vein to Microsoft and Intel were 15 years ago.

But whereas the PC forged the ideal of the personal computer, allowing you your choice of apps or operating system, the tablet market has matured into a very different beast, where the choice of platform is as important a decision as the device you purchase.

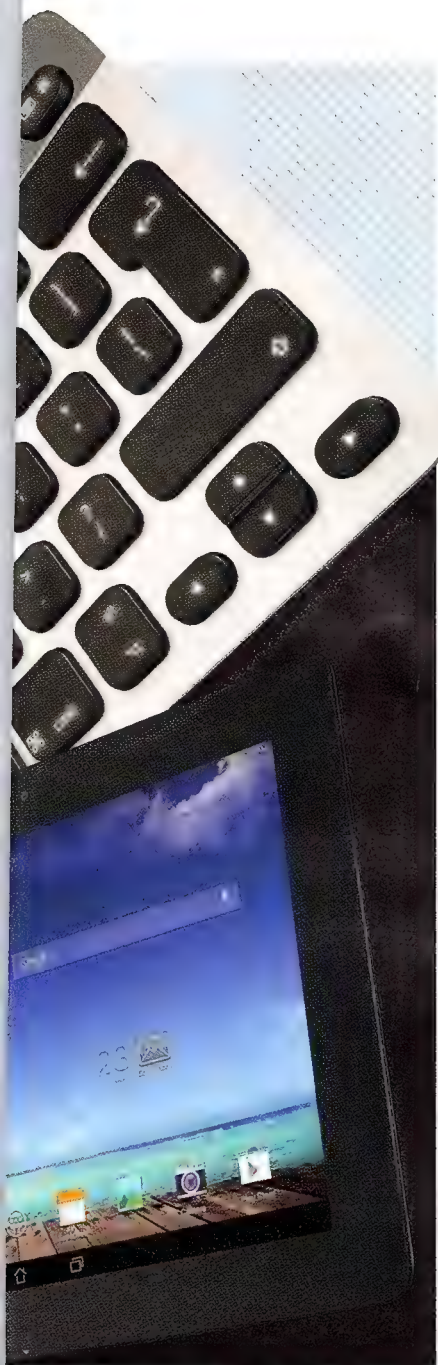
After all, the platform is where the money is – just ask Apple, Google and Microsoft. But why does platform choice matter?

APPLE iOS

Apple's position of owning virtual every element of its entire iOS ecosystem is unique and a river of untold riches. But one potential issue is the lack of choice among Apple tablets, particularly as its market share continues to fall in the face of overwhelming Android product numbers. According to ABI Research, Apple's share of the estimated 285 million worldwide 'big brand' tablet install base had dropped to 51% by the end of 2013, with Android rising to 40% (tinyurl.com/2013tablets).

But in terms of app development, iOS still holds sway for two commonly-held reasons. First, Apple's limited number of screen resolution options simplifies app development compared with the seemingly vast array of Android options. However, we've seen one report counter this with claims overall development time for Android apps is now less than iOS (tinyurl.com/appdevtime).

The second is the view that Apple users are more prepared to pay for apps than Android users, but this too is an argument as stable as a sinkhole. Gaming apps bring in more cash than any other app type and despite Apple's 18% global market share, iOS games still bring in twice the cash of those on Google Play (tinyurl.com/



mobilerevenue). However, another report claims the revenue return is nearer 50-50 (tinyurl.com/revgapshrink). Whatever the case, by releasing comparatively few products, the pressure grows on Apple to make each product a commercial success to maintain its ecosystem size.

GOOGLE ANDROID

This is something Google doesn't have to worry about. While it continues to work with a small rotation of tier-one names making its own branded marquee products, the vast numbers of devices running Android worldwide gives the search giant a potentially winning hand (tinyurl.com/andtabshare). Android not only has the benefit of multiple hardware partners, but multiple CPU suppliers – Qualcomm, Marvell, Nvidia, Intel, Rockchip, Allwinner, Samsung, MediaTek and the list goes on. Whatever your device design starting price in mind, there's a CPU to meet it.

However, Android isn't without its issues. While every iPad bar the first-gen is virtually guaranteed to run any new iOS update, most Android devices may only see one, two updates if they're lucky. I have two brand-name early-gen Android dual-core tablets now orphaned at Ice Cream

in tablets and Windows RT on life-support, Microsoft is now reliant on Intel to bring the Windows tablet to life. But the recent release of new 'Bay Trail' quad-core Atom CPUs suggests the old 'Wintel' team isn't quite done yet. The shift away from the Windows RT sideshow and the rise of new full-version Windows tablets under \$400 should see business users lap up the benefits of a platform that can run desktop apps. Throw in improving performance and battery life and Windows tablets could well be the dark horse for 2014.

WHAT WE FOUND

And that's the snapshot we found and you'll see in the current crop of tablets – Apple's iPad Air and mini Retina are premium products at premium prices; Android models we tested varied in price from \$200 to \$1,100 and the x86-Windows market is finally hitting its straps.

Three models that caught our eye in particular were HP's Omni 10, the Gigabyte Tegra Note 7 and the iPad Air. HP has somehow managed to squeeze in a quad-core Atom CPU, 10-inch full HD-plus screen and Windows 8.1 OS for under \$400; the Nvidia-designed Tegra Note 7 is mind-bogglingly fast for its sub-\$250 price tag; and the iPad Air continues to defy logic

"The iPad Air continues to defy logic with almost the best battery life and the lowest weight of any 10-inch tablet."

Sandwich/4.0. With the sale made, it seems there's little incentive for hardware vendors to continually contribute to software updates they can't charge for, however short-sighted that view may be.

And with so many devices unable to run or receive the latest OS, the question of security invariably arises, one that's descended into a now long-running feud between anti-virus vendors and Google, with Google saying Android is secure (tinyurl.com/andsecurity) and anti-virus vendors running the opposite headlines (<http://tinyurl.com/mobmalware>).

MICROSOFT WINDOWS

Microsoft fights from the weakest position of the three. Its attempt to marry the desktop with mobile in Windows 8 hasn't been a roaring success. Although, while looking shaky early on, the Windows mobile ecosystem is now humming, recently reaching 400,000 apps – but in an x86-tablet market where almost every desktop app is a potential tablet app, numbers are irrelevant.

However, Windows 8 is still essentially a desktop OS running on a tablet platform and the hardware was always going to be critical. With AMD seemingly uninterested

with almost the best battery life and the lowest weight of any 10-inch tablet.

The sub-\$400 tablet market is bursting with product at the moment, but you need to be wary – in our view, it's a real minefield with some terrific models interspersed with others well passed their use-by date. Dive below \$200 and the pickings are very slim so keep your wits about you and your expectations realistic.

Our advice is go for the best mix of screen quality, battery life, weight and performance (roughly, in that order) your budget can afford. Don't get sucked into gimmicky features, designs or add-ons – buy what you need. And make sure you shop around – even ask for a discount. Few retailers will budge on Apple prices but there seems to be considerable fluidity in Android and Windows pricing between retailers, so it literally pays to ask for a discount. And if you plan to buy online, make sure you buy in Australia if you want a local warranty.

Even with 14 tablet reviews, this is just a taste of the market – but it'll give you a good feel for what's available and importantly, what features (and problems) you need to look out for.



iOS

\$598 | WWW.APPLE.COM/AU

APPLE IPAD AIR

Almost the
perfect tablet.



When Apple launched the third-gen iPad, it came with a noticeable weight gain, thanks to its larger battery required to power the new dual-core A5X CPU, the Retina-resolution screen and maintain its famed ten-hour battery life. Clearly, this wasn't ideal but an apparent limitation of the tech available. The new iPad Air solved those issues with the new A7 chip, leading to a significantly reduced battery capacity needed to last the ten-hours and making the Air the lightest iPad so far.

However, this is also the first iPad to feature the new 64-bit iOS 7 release. While Apple at the time of launch told us the reason for 64-bit was to improve file uniformity between its mobile and desktop environments, 64-bit apps require on average around 20% more memory compared with 32-bit versions. But the Air arrived with the same 1GB RAM compliment, which effectively meant a RAM

reduction. Some users have said the recent 7.1.1 update fixes some memory-related issues, but others may remain. While it likely comes down to how you use the device, it could all be sorted by Apple just upping the RAM to 2GB. Google's Nexus 7 now comes with 2GB of RAM so it can't be that hard. Maybe in this year's Air revision?

Overall, though, the 1GB of RAM is the only blight on what otherwise is a damn good tablet – no tablet of equivalent size matches it for weight, battery life and performance. The only reason not to buy one yet is the hope of seeing 2GB in the next model.

Verdict

We think its short 1GB of RAM, but the Air is still the tablet to beat.



\$479 (16GB Wi-Fi) | WWW.APPLE.COM/AU

APPLE IPAD MINI RETINA DISPLAY

Speed, battery life and good
screen justify the high price.



With its \$479 price tag, the iPad mini Retina display is the most expensive compact tablet going around. But what's impressive about this 7.9-inch model is how it performs. Apple's display processing continues to be as buttery smooth as your grandmother's shortbread and despite Google's own similarly-focussed 'Project Butter', the iPad still looks fractionally smoother (no, I'm not a fanboy).

Despite that smooth appearance, the Apple A7 processor was outgunned by Gigabyte's Nvidia Tegra 4 chip on 3Dmark IceStorm Unlimited by a bit over 10%, which was a surprise. Apple's combination of new 64-bit iOS 7 and only 1GB of RAM is a concern here, too, and we'd like to see Apple up this to 2GB as soon as possible, even if it meant an extra \$20 on the price.

Still, the iPad mini wins when you combine speed, screen resolution, battery life and weight. The battery life of 10:15hrs from a tiny 23-watt-hour battery is

quite remarkable, particularly given the performance the A7 is capable of. Throw in the low 330-gram weight for the Wi-Fi only version and this is a potent mix.

Packing 2,048 x 1,536-pixels into a 7.9-inch IPS panel means colours aren't just great, you can forget spotting any pixels – few can match the pixel density here. Plus, you also still get HDMI output via the optional Lightning Digital AV Adapter.

But the key to the mini is that A7 processor – it's able to deliver performance and battery life that's still hard to beat.

Verdict

Same RAM issue as the iPad Air, we think, but still a stand-out tablet.





WINDOWS

\$449 | WWW.ACER.COM.AU

ACER ICONIA W4

A competent Windows tablet, but it's a tad overpriced.

While heavyweights in the PC market have shelved their Windows RT tablets, Acer's new Iconia W4 joins the growing number of new compact x86 Windows models. But in this group at least, the W4 comes with the highest price tag of \$449.

The 8-inch screen delivers the same basic specs as the Toshiba Encore – standard TFT LCD and 1,280 x 800-pixel resolution. Both also use the same quad-core Atom Z3740 processor. But while they deliver the same office-level performance, there was a significant difference on 3D processing, with the W4 way out in front. Since both also use Intel's HD graphics engine, we haven't been able to nail down why the difference.

Still, the key point is don't underestimate new Atom CPU performance – it's not desktop level, but enough to give ARM some headaches.

Unlike the HP, the W4 charges via microUSB and you also get a separate microHDMI video output. The storage on this release

is the standard 32GB base-level, but 64GB versions also exist, with and without 4G network connectivity. The MicroUSB port also handles OTG, so it'll connect to external storage devices as well.

The 4960mAh Lithium-ion battery lasted 8:35hrs on our continuous Wi-Fi video testing – 10 minutes more than the Toshiba and 20 minutes behind the HP. Platform-wise, that's roughly two hours behind Apple but on par with Android tablets.

Still, Acer will be rowing up-stream to sell this at \$449, particularly given the cheaper, larger (and, frankly, better) HP Omni 10 – not to mention Toshiba selling essentially the same thing for \$100 less.

Verdict

Acer's \$449 asking price doesn't stack up well against Toshiba and HP.



\$399 | WWW.HP.COM/AU

HP OMNI 10

Microsoft and Intel are getting the band back together.

Little more than 12 months ago, Microsoft was hard at it, promoting the need for an ARM-based Windows RT tablet at a time when Windows tablets were generally big, heavy and expensive. HP's new Omni 10 – an Intel x86-powered tablet with the full Windows 8.1 release – should be reason enough now to give Windows RT the last rites.

That HP can offer the Omni 10 for under \$400 is more impressive still – neither of the other Windows tablets we saw could match this hardware for the price.

The key to good tablet design has always been CPU speed, battery life, weight and screen quality. HP nails those features here and at a price that's hard to believe.

The Omni 10 is powered by the new quad-core 'Bay Trail' Atom Z3770, 32GB of flash and 2GB of RAM, but it's the 10-inch/1,920 x 1,200-pixel panel that is the surprise packet here. It's remarkably good, given the price tag. Battery life from

its 8500mAh battery turned out at a tick under nine hours, which is nothing to sneeze at and better than a few Android models we tested. We're further impressed the Omni 10 does all of this with an iPad 3-like 648-grams weight.

There's no USB charging, instead you use a supplied DC-plugged power brick.

Running the Windows 8 desktop without a stylus is still a bit of a problem, but with HDMI, USB-OTG, decent battery life and good speed, it looks like the Wintel alliance still has a trick or two to show those market young'uns.

Verdict

The surprise of the roundup and the first Windows tablet you must see.





\$349 | WWW.TOSHIBA.COM.AU

TOSHIBA ENCORE

The cheapest x86 Windows tablet we've seen.

With HP laying down the gauntlet with its \$399 Omni 10, other Windows tablet vendors are having to work harder to compete. Toshiba's new Encore was actually the cheapest Windows tablet we saw at \$349. At that price, you get just the tablet but there's a raft of optional extras available including case, Bluetooth keyboard and stylus. As it is, it's slightly slower than the HP, featuring Intel's 1.33GHz quad-core Atom Z3740 chip with 2GB of RAM and full Windows 8.1 OS.

However, on the PCMark 8 benchmark, the difference between the two is quite modest. The 8-inch panel is passable with 1,280 x 800-pixel resolution, but we reckon you'll need good eyesight – particularly running desktop apps and trying to use the system tray icons. The pixel density on this and the Acer W4 makes these icons incredibly small, something we suggest you'll want to see before you buy. Apart from the usual wireless features,

there's a microHDMI port and the microUSB port supplies charge power as well as OTG functionality, which unfortunately makes external storage and power at the same time a little more problematic.

Vendors appear to have settled on 32GB as the entry-level storage mark, double what you find on Android, but only because Windows 8.1 itself takes up around 12GB.

One surprising aspect was its battery life – 8:25hrs was the worst result of the three Windows tablets but that's much improved from last year. If you can get past the small desktop icons, it's not bad for the price.

Verdict

We never expected to see an x86 Windows tablet at Android prices.



ANDROID
\$198 | WWW.ACER.COM.AU

ACER ICONIA A1-830

Where have we seen this before?

Acer's new Iconia A1-830 is a rare mix – an Intel CPU with Android OS – and while it has a retail price of \$249, you'll find it for as little as \$198 on promotion, making it the cheapest tablet we saw. We didn't have time to try it but it'll be interesting to see if a hack develops to install x86-Windows on it.

Intel's previous-gen dual-core 1.6GHz Atom Z2560 CPU powers this one, combined with PowerVR SGX544 graphics. But despite the ageing tech, the A1-830 gives Samsung's quad-core Exynos 4412 chip inside the Galaxy Note 8.0 a bit of a touch-up on 3DMark, so it's no slouch. The A1-830 shipped in Australia now has an Android 4.2.2 update available – still, you can't exactly call that 'new'. Whether the lack of KitKat readiness is a design issue or otherwise, remains to be seen. Of course, it goes without saying that the shell design looks just slightly familiar.

While the IPS panel is passable for colour quality,

the 1,024 x 768-pixel resolution also ages this one considerably and no doubt contributes to its sub-\$200 promotional price. The dead pixel near the centre of the screen on our test unit didn't help our impression.

The 4000mAh Lithium-ion battery lasted 6:13hrs on our continuous video playback test – not a great result, but expected, given the 2013-era tech. If you can find the A1-830 for under \$200, it's a passable buy – few tablets at this price can boast an Intel CPU. Problem is, for not much more, there are far more interesting alternatives.

Verdict

Last year's tech with last year's battery life. Still, it's cheap enough.





\$649 | WWW.ASUS.COM/AU

ASUS TRANSFORMER TF701T

Arguably the best-value tablet around.

ASUS' popular TF701T Transformer has a retail price of \$649, but look hard online and it can be had for about \$550. Despite being around since last September, this is still one exceptional tablet, combining the same Nvidia Tegra 4 CPU found inside the Tegra Note 7 with a 10.1-inch screen and impressive 2,560 x 1,600-pixel resolution. The difference is, the TF701T also throws in a keyboard dock with a 16-watt-hour battery, in addition to the battery inside the tablet proper. Not that we're sure you'll need it – 10:34hrs runtime on video playback testing suggests the internal 8400mAh battery alone should last the longest of days.

When we tested this one earlier in the year, it only featured Android 4.2.2, but there is now a new Android 4.3 update available and we hear KitKat is on the way.

Its GeekBench 3.0 performance came second only to the flying Galaxy

NotePRO and comparatively not by all that much, given the hefty price difference. The all-up weight sees this tipping the scales at around 1.15kgs, but that's almost equally split between the keyboard dock/base and the tablet itself. Having that much weight in the screen made it feel just a touch 'top heavy' to us, so best to try it before you buy. Up against the Galaxy NotePRO, you're getting about 80% of the NotePRO's performance for about 60% of the price, near enough to double the all-up battery life with much greater versatility thrown in. All up, it's still the best 10.1-inch Android tablet available.

Verdict

Aging well, this is still the most versatile Android all-rounder.



\$249 | WWW.GIGABYTE.COM/AU

GIGABYTE TEGRA NOTE 7 P1640

A real pocket tearaway for a great price.

One of the fun little surprises out of this roundup was this Tegra Note 7 from Gigabyte. Well, it's not really from Gigabyte – it's an Nvidia reference gaming tablet design you'll also find online branded from EVGA, HP and 'Advent' in the UK. The Gigabyte version punches well above its weight, offering performance and battery life for a price that borders on insanely good.

Powered by Nvidia's ARM Cortex A15/4+1-core Tegra 4 CPU and incorporating the latest KitKat/Android 4.4.2 updates, this little dynamo outclassed the iPad mini Retina display by better than 10% on the 3Dmark IceStorm cross-platform benchmark test and still managed better than 9:30hrs battery life on continuous video playback. Throw in the built-in stylus and it's more versatile than Nvidia's Shield without sacrificing its gaming chops.

The 7-inch panel is a decent widescreen IPS model, but with only 1,280 x

800-pixel resolution, it's not as crisp as the Nexus 7 and a calculated gamble by Gigabyte/Nvidia, who clearly hope not having 1080p resolution at this size won't matter. Having 1GB of RAM is disappointing, but not a deal breaker.

The Tegra Note 7 has two things in its favour, though – an extra 90 minutes battery life compared with the Nexus 7, plus an impressive \$249 price tag. It also features microHDMI output and OTG-ready microUSB.

It might not be perfect, but compared to some we've seen, this is a little pocket rocket. If you only have \$250 to spend, have this on top of your list – but have a sneak peak at a Nexus 7 if you can.

Verdict

A terrific mix of performance and battery life, you won't find a better tablet under \$250.





\$299 | PLAY.GOOGLE.COM

GOOGLE NEXUS 7 (2013)

Still the gold standard for 7-inch Android tablets.

When Google first entered the hardware market, seven-inch Android tablets with decent performance from name-brands sold for over \$500. Last year's ASUS-built Nexus 7 has aged a bit in this roundup but at \$299, it's still one of the best you'll see.

Qualcomm's Snapdragon S4 Pro continues to be an excellent performer, despite no longer sitting at the top of the performance tree, but its combination with the 1,920 x 1,200-pixel resolution IPS panel still rocks — no other tablet can match this for under \$300. Being Google-branded, the Nexus 7 will also do better than average for Android updates and already has KitKat/4.4.2 available.

If there is anything suggesting a complaint about this one, it's the battery life, which on our testing, just fell over the line at eight hours. Again, even Windows x86 tablets now pass this routinely, although it must be said, few will do so with a sub-300g

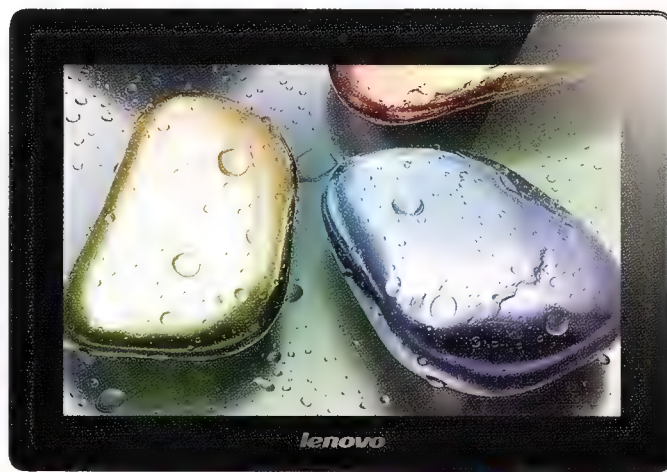
weight. The 3950mAh battery is the smallest we saw, which won't do much for battery life, despite keeping the weight down.

You can get external HD video, but it's through the microUSB connection using the less-common 'SlimPort' standard. SlimPort-to-HDMI adapters are available online from \$10. The inclusion of 2GB of RAM should keep this one well happy, whatever apps (or OS) you install.

But overall, it shows just how far ahead of its time this Nexus 7 was when launched last year that the competition is only just now starting to catch up. For \$300, it continues to be the closest example to perfection in a 7-inch Android tablet.

Verdict

You still won't find another tablet at this price deliver as much as the Nexus 7.



\$288 | WWW.LENOVO.COM/AU

LENOVO IDEATAB S6000

For the price, a passable buy.

The boom in compact 7- and 8-inch Android tablets seems to have come at the expense of the larger 10.1-inch models, which makes this Lenovo IdeaTab S6000 reasonably rare, especially for under \$300. The basic formula for tablets is 'performance + screensize = price' — you can't increase the first two parameters without increasing the third. The S6000 does well to deliver a big 10.1-inch screen for a small \$288 price tag, but it comes at the cost of performance.

It's powered by MediaTek's 1.2GHz MTK8125 processor, a modest-performing quad-core chip based on ARM's Cortex A7 core design and well down on the Cortex A15 chips you'll see elsewhere. That shows up on benchmark performance, particularly gaming. Another factor affecting price is the screen pixel count — elsewhere we saw small screens delivering high resolution. Here, the 10.1-inch I-PS screen only

offers 1,280 x 800-pixel resolution, making pixel density quite low.

Battery life was adequate, reaching 8:19hrs on our continuous video playback test, although smaller, faster tablets such as the iPad mini Retina and the Tegra Note 7 are exceeding this by an hour or more. At 550g, it is one of the lightest tablets of its size and no other name-brand 10-inch tablet can match the S6000 for price (you can buy two of these for an iPad Air). The built-in microHDMI output is a worthwhile addition.

All up, provided your ambitions for the S6000 are modest, it's fair value — but there are too many other tablets to check out first before stopping here.

Verdict

One of the very few name-brand 10-inch Android tablets under \$300.





\$348 | WWW.LENOVO.COM/AU

LENOVO YOGA TABLET 10

Fancy shell, but lacking some features.

The Yoga Tablet 10 from Lenovo is probably known for its promotion by actor Ashton Kutcher as much as its metal chassis, asymmetrical barrel design and rotating base. In practise, we see it more as a re-chassised IdeaTab S6000.

Originally selling for \$399, the Yoga 10 has the same screen size and type, plus the same processor and storage capacity as the cheaper S6000. One of Lenovo's key marketing messages here has been 'up to 18 hours of battery life', however, the fine print includes 12 hours of e-book reading in that run time. On our own battery testing, the Yoga 10 gave up after 11:11hrs – well ahead of the S6000 and even ahead of the Apple iPad Air. But despite the premium branding, it's still essentially a budget tablet, given the comparatively moderate-performing MediaTek's MTK8125 CPU. The lack of video output options didn't thrill us either.

Depending on your

application, the size and price of the Yoga may suit you, but we're not sold on the Yoga design. That swing-out barrel-hinged base adds extra capacity to the battery and even doubles as a stand, but we found it far too difficult to move easily and made the tablet harder to hold.

The fact it delivers three-hours-plus extra battery life compared with the S6000 is obviously a plus. The recent \$50 price drop won't hurt either. But \$50 more buys you the HP Omni 10 with its 1,920 x 1,200-pixel screen – definitely worth keeping in mind.

Verdict

Great battery life but sluggish performance and a design we found difficult to use.



\$374 | WWW.SAMSUNG.COM/AU

SAMSUNG GALAXY NOTE 8.0

Starting to show its age.

Samsung has certainly been busy flooding the market with Android tablets, including this Galaxy Note 8.0, which has been around for more than a year now and unfortunately, the ravages of time are starting to show.

On the Samsung performance ladder, the Note 8.0 is a step up from the Galaxy Tabs, thanks largely to its Exynos 4412 quad-core CPU (if you need help, that's the chip inside the Aussie version of the Galaxy S3 phone). But the screen is fairly ho-hum, a straight 1,280 x 800-pixel TFT offering. It's surprisingly light at 340g, just nine grams heavier than the iPad mini Retina. That light weight is helped by a relatively low-capacity battery at 4600mAh (the iPad mini's is 6400mAh), which contributed to a battery life on our testing of only 6:35hrs. Last year, that would've been passable; this year, no – when even Windows x86 tablets can make eight hours, anything

under is very '2013'.

Samsung differentiates the Note range with a supplied stylus and its own custom TouchWiz front-end. Like most recent Samsung devices, it features the 11-pin MHL/USB port to also give you HDMI video output.

The Exynos 4412 CPU runs four basic ARM Mali 400 GPUs – they're adequate for gaming, but not really for the \$374 asking price. And that's the problem – given what \$350-\$400 buys you elsewhere, the Galaxy Note 8.0 doesn't deliver enough in the key performance areas. It needs a sub-\$300 price tag to be worth a serious look.

Verdict

Weak battery life, par-level performance and high price hurt this one.





\$1,098 | WWW.SAMSUNG.COM/AU

SAMSUNG GALAXY NOTEPRO

A statement piece, but what's with the price?

If you're after the benchmark for Android tablets – at least for size and price – this is it. Samsung's brand-new Galaxy NotePRO features a huge 12.2-inch LCD panel with 2,560 x 1,600-pixel resolution and comes with an equally-sizeable \$1,098 price tag. But, you do get a bit for your money here. Samsung's new Exynos Octa 5420 CPU delivers eight cores – four Cortex A15s and four A7s for about as much speed as you'll get in a tablet currently. It showed up in the benchmarks too with clearly the highest GeekBench 3.0 score we saw.

While that LCD panel packs in over four million pixels, we can't say it's the best-looking panel we've ever seen. We felt the contrast ratio was a little on the 'low' side with near-blacks hard to distinguish. Given the high price tag here, that's a bit tough to swallow.

The toughest challenge for a tablet of this size though is achieving good

battery life without too much weight. Generally, the larger the tablet screen, the greater the power drain through the screen itself – not only the pixels, but the backlight as well. With its huge 9000mAh battery, the NotePRO managed 8:53hrs, which isn't a bad effort for its reasonable 753g weight (reasonable for a 12.2-inch tablet). It comes with Samsung's S Pen stylus but no wireless keyboard or cover.

But the main problem is at \$1,098 street price, you can buy two of almost anything else.

Or you can buy it in the US – it's just \$650 over there. Don't you love buying tech in Australia?

Verdict

A V8 in a field of 'hot hatch' tablets, but with a Formula-One price tag.



\$298 | WWW.SAMSUNG.COM/AU

SAMSUNG GALAXY TAB 3 8.0

It's time Samsung released the Galaxy Tab 4 series.

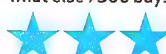
We have to say we find Samsung's tablet strategy just a bit odd. For a big-name brand, it seems to have chosen the budget Toyota Yaris route to tablet riches, rather than come out with a Subaru WRX STI-style performance compact tablet. This 8-inch sample of the Galaxy Tab 3 range is powered by Samsung's own dual-core Exynos 4212 CPU. Keeping in mind the Apple mini Retina sets the price benchmark at \$479, the Tab 3 seems like decent value at its \$298-\$330 street price. The 4450mAh battery is smaller than that of the Galaxy Note 8.0, but with its dual rather than quad-core CPU, it managed to fall over the line right on eight hours in our testing, the minimum life you should expect these days. The \$70 or so price difference between this and the Note 8.0 is about right in terms of the performance levels as well – and that's a problem for the Galaxy Tab 3 range. The Note 8.0 isn't that quick.

You get nice extras,

including Miracast support and Samsung's 11-pin MHL that also packs in HDMI video output, but at this price, the app performance doesn't stand up well. When Google's Nexus 7 delivers the excellent Qualcomm Snapdragon S4 Pro for the same price and Gigabyte can do the lightning-quick Nvidia Tegra Note 7 for \$50 less, the Tab 3 8.0 isn't compelling. Samsung needs to give its tablets the same flare it does the Galaxy S-series phones. Bottom line, if you want a brand-name tablet under \$300, this fits the bill, but there are better offerings around if you look.

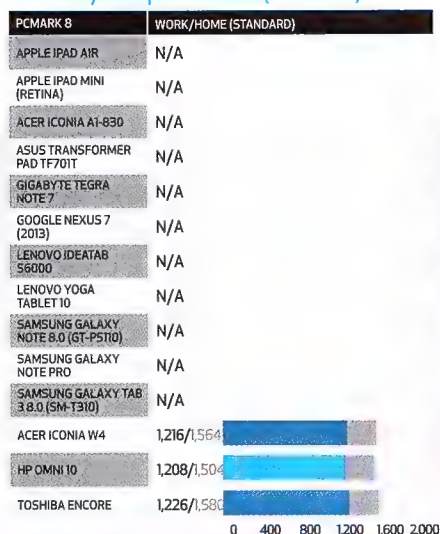
Verdict

Some nice extras, but it's too slow for the price, particularly given what else \$300 buys.

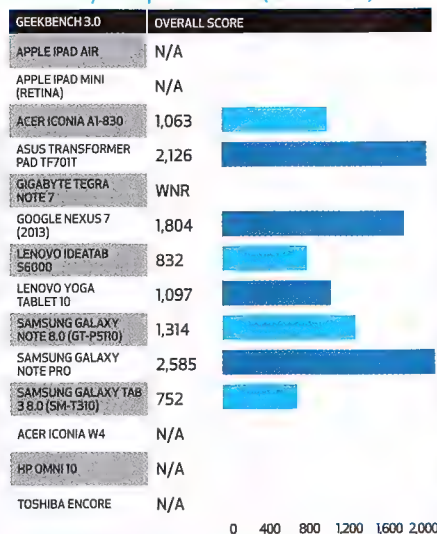


LABS BENCHMARK RESULTS

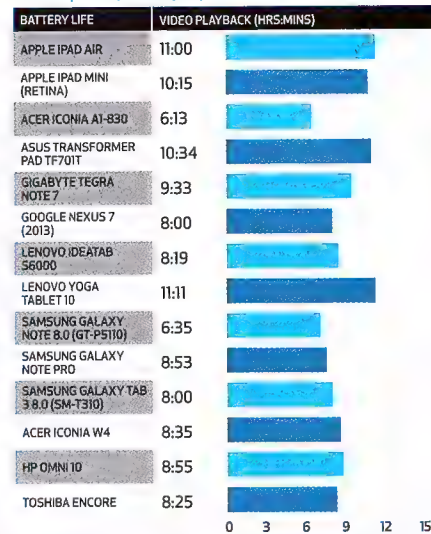
General system performance (PCMark 8)



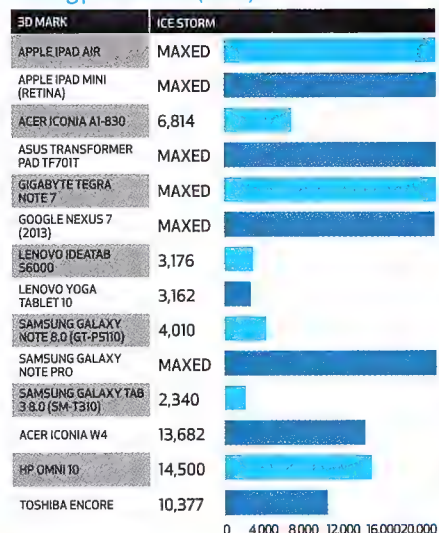
General system performance (GeekBench)



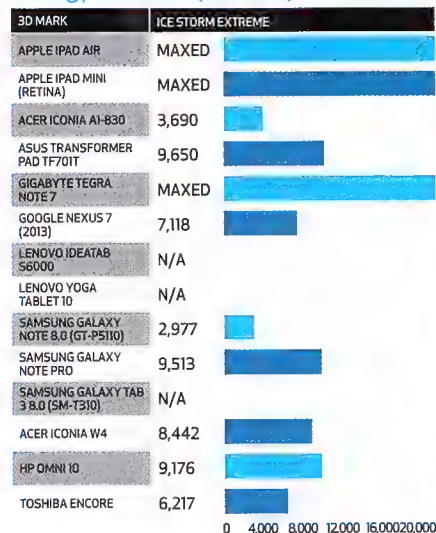
Battery life (video playback)



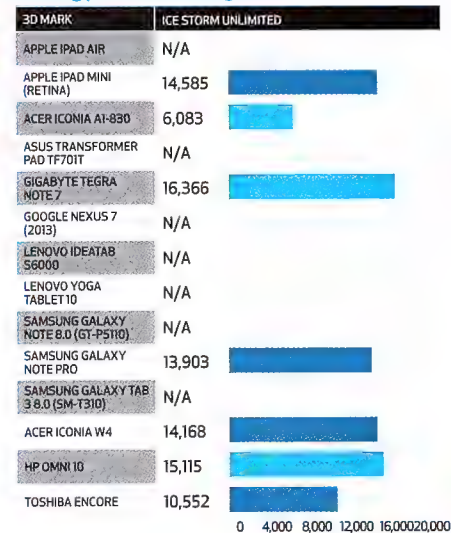
Gaming performance (basic)



Gaming performance (moderate)



Gaming performance (high end)



NOTES: WNR - WOULD NOT RUN.

TABLET SPECIFICATIONS

	IOS		ANDROID							WINDOWS				
MODEL	APPLE IPAD AIR	APPLE IPAD MINI (RETINA)	ACER ICONIA A1-830	ASUS TRANSFORMER PAD TF701T	GIGABYTE TEGRA NOTE 7	GOOGLE NEXUS 7 (2013)	LENOVO IDEATAB S6000	LENOVO YOGA TABLET 10	SAMSUNG GALAXY NOTE 8.0 (GT-P5110)	SAMSUNG GALAXY NOTE PRO	SAMSUNG GALAXY TAB 3 8.0 (SM-T310)	ACER ICONIA W4	HP OMNI 10	TOSHIBA ENCORE
OPERATING SYSTEM	APPLE IOS 7.0.4	APPLE IOS 7.1.1	ANDROID 4.2.2	ANDROID 4.2.2	ANDROID 4.4.2	ANDROID 4.4.2	ANDROID 4.2.2	ANDROID 4.2.2	ANDROID 4.2.2	ANDROID 4.2.2	ANDROID 4.2.2	WINDOWS 8.1 (32BIT)	WINDOWS 8.1 (32BIT)	WINDOWS 8.1 (32BIT)
SCREEN-SIZE/TYPE	9.7-INCH IPS	7.9-INCH IPS	8-INCH TFT LCD	10.1-INCH IPS	7-INCH IPS	7-INCH IPS	10.1-INCH IPS	10.1-INCH IPS	8.0-INCH TFT LCD	12.2-INCH TFT LCD	8.0-INCH TFT LCD	8.0-INCH TFT LCD	10.1-INCH LCD	8.0-INCH TFT LCD
SCREEN RESOLUTION (PIXELS)	2,048 X 1,536	2,048 X 1,536	1,024 X 768	2,560 X 1,600	1,280 X 800	1,920 X 1,200	1,280 X 800	1,280 X 800	1,280 X 800	2,560 X 1,600	1,280 X 800	1,280 X 800	1,920 X 1,200	1,280 X 800
PROCESSOR	1.4GHZ APPLE A7 'CYCLONE' (2 CORE)	1.4GHZ APPLE A7 'CYCLONE' (2 CORE)	1.6GHZ INTEL ATOM Z2560 (2 CORE)	1.9GHZ NVIDIA TEGRA 4 (4+1 CORE)	1.8GHZ NVIDIA TEGRA 4 (4+1 CORE)	QUAL-COMM SNAP-DRAGON S4 PRO (4 CORE)	1.2GHZ MEDIATEK MTK8125 (4 CORE)	1.2GHZ MEDIATEK MTK8125 (4 CORE)	1.6GHZ SAMSUNG EXYNOS 4412 (4 CORE)	1.9GHZ SAMSUNG EXYNOS 4212 (2 CORE)	SAMSUNG EXYNOS OCTA 5420 (8 CORE)	1.33GHZ INTEL ATOM Z3740 (4 CORE)	1.46GHZ INTEL ATOM Z3770 (4 CORE)	1.33GHZ INTEL ATOM Z3740 (4 CORE)
RAM/STORAGE (GB)	1/16	1/16	1/16	2/32	1/16	2/16	1/16	1/16	2/16	3/64	15/16	2/32	2/32	2/32
VIDEO OUT OPTION	LIGHTNING (HDMI)	LIGHTNING (HDMI)	NONE	MICROHDMI	MICROHDMI	SLIMPORT (HDMI)	MICROHDMI	NONE	11-PIN USB (MHL)	11-PIN USB (MHL)	11-PIN USB (MHL)	MICROHDMI	MICROHDMI	MICROHDMI
BATTERY TYPE/CAPACITY	8750MAH LI-PO	6400MAH LI-PO	4000MAH LI-ION	8400MAH (TAB) & 4400MAH (DOCK) LI-ION	4100MAH LI-ION	3950MAH LI-ION	6350MAH LI-PO	9000MAH LI-ION	4600MAH LI-ION	9500MAH LI-ION	4450MAH LI-ION	4960MAH LI-ION	8500MAH LI-ION	2-CELL LITHIUM-ION
WEIGHT (GRAMS)	469	331	380	579 (TAB), 572 (KEY PAD)	320	290	550	609	340	753	314	430	648	450

TABLET CASES

Protect your purchase, says Alex Kidman

Depending on your aesthetic sensibilities, putting a case on a tablet might just be an act of visual vandalism, due to the effort that designers put into making tablets look so gosh-darned pretty.

Meanwhile, in the real world, there's a very sensible argument for putting some kind of case or cover onto the tablet of your choice, and that's because outside the really scrappy little budget numbers, they're not cheap. Actually, the budget numbers can be cheap, but there you might find the case outlasts the tablet – if you can find a case, that is.

While Android and Windows tablets have been making serious inroads into the tablet space, aftermarket cases for anything that doesn't have an Apple or Samsung badge upon it is quite hard work. It's not impossible, but it can take some looking around unless you want to buy a case from the same manufacturer, and you may find yourself limited to one or two models.

Conversely, if you are a Galaxy Tab owner, or particularly an iPad owner, you're rather spoilt for choice, with cases that offer improved durability, style changes and easy viewing angles aplenty.

Verdict



APPLE IPAD SMART COVER/CASE
\$48-\$99 | WWW.APPLE.COM.AU

Apple's duo of covers are rather well known by this point, offering either a simple leather cover that attaches magnetically with a robust folding mechanism, or the same thing with a simple rear cover as well, to cover for the criticism that the smart cover does absolutely nothing to protect the rear of the iPad. Both allow for quick switching on and off of the iPad via inbuilt magnets in the cover.

Not surprisingly they fit very well and allow excellent access to ports and switches on the iPad Air and Mini, and they're very solidly built. The biggest issue with the Smart Case and Cover are the asking prices, because like all things Apple, they're priced at a premium level.

BELKIN FORMFIT COVER
\$39.95 | WWW.BELKIN.COM.AU

Want an iPad Air Smart Case but don't feel like paying Apple's rather hefty prices? That's pretty much the mission statement of Belkin's FormFit cover, which keeps the same slim aesthetic as the Smart Case, although you don't quite get the exact same experience. It is quite slim if you're fussed about bulking up the iPad Air, but you forego the magnetic clasp that switches the iPad Air screen on and off in favour of a cheaper plastic clasp, as well as a single plastic tab that holds it in one of four positions, albeit in a somewhat wobbly fashion.

Verdict



apc
RECOMMENDS



BELKIN LAPSTAND COVER

\$59.95 | WWW.BELKIN.COM.AU

The Lapstand Cover's big innovation, if you can call it that, is that it'll sit comfortably in your lap. You didn't see that coming, right? It's otherwise a standard folio cover with a soft oval of material in the middle of the folio back that also makes it very comfortable to quickly grip. There are a few gripes here, though. It's a bit fiddly to fit an iPad Air into the four holding brackets on the LapStand Cover, and when they're in place the mute/orientation lock switch can be difficult to switch on if you've got larger fingers.

Verdict



BELKIN MULTITASKER

\$69.95 | WWW.BELKIN.COM.AU

The Multitasker case has a nice natural leather cover that gives it a somewhat business-centric feel. That's an impression that lasts when you open it up to discover two business card slots on the inner cover. There's a magnetic clasp to hold it shut, which it does well, although it's somewhat annoying when open because while there's a magnet on the other side for it to fold down onto, it's very weak, and tends to flap around in the way of the screen. Tiny tags on the side of the case correspond with slots on the inner cover to form the Multitasker's four different viewing angles. They're reasonably solid, although you may initially slide around a little getting them to fit in.

Verdict



BELKIN STRIPE TAB

\$49.95 | WWW.BELKIN.COM.AU

The Belkin Stripe Tab cover is a regular folio case with a strong magnetic clasp. Unlike the very similar MultiTasker Cover for iPad Air, however, the magnetic clasp folds over neatly when you've got it open with strong attraction. They're otherwise near clones of each other, with the same four landscape positions that lock into place with small plastic tabs on the side of the plastic mount that the iPad Air sits in, which means the essential choice here is whether you prefer the showier leather MultiTasker or the cheaper plastic Stripe Tab.

Verdict



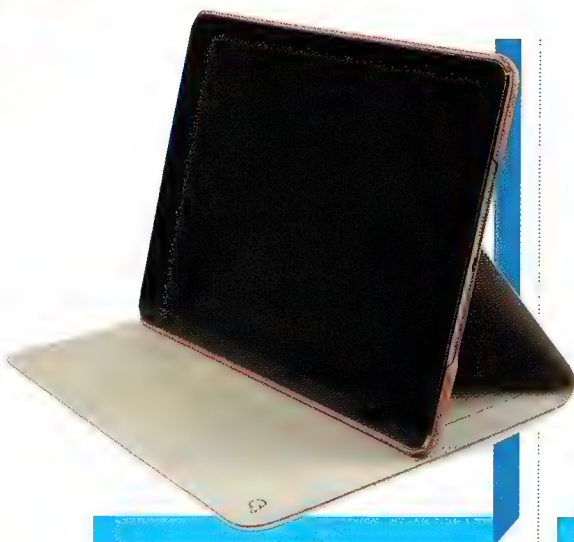
BELKIN TRIFOLD COVER

\$39.95 | WWW.BELKIN.COM.AU

Like the FormFit Cover, Belkin's Trifold cover takes an aspect of Apple's much pricier Smart covers and offers it at a significant price discount. That aspect is rather inherent in the naming of this cover, which folds down into a triangle to provide a single landscape propped up viewing angle. It's a very solid cover, which is good from a protective standpoint, but less enticing if you're keen to keep your iPad Air as thin as possible.

Verdict





CYGNETT CACHE
\$59.95 | WWW.CYGNETT.COM

The Cache is certainly a slim case, but it's also not particularly feature heavy. It's got the same basic textured fabric feel of Cygnett's basic case, so it's not particularly showy, and mild protection aside, the only other feature is a pair of rather slender business card holders on the inside of the folio case front. There's a single supported viewing angle via folding the case cover back on itself. At a basic level the Cache is acceptable, but it's in no real way enticing.



CYGNETT NODE
\$39.95 | WWW.CYGNETT.COM

The Node sells itself as a basic case, but we'd almost be tempted to go for rudimentary as a better descriptor. It's certainly functional, but there's little that's appealing about this particular case beyond the price, with a single viewing position, simple elastic straps to hold your iPad Air in place and a small interior pocket on the inside of the folio cover. If you want a case to scream "I bought a cheap case", this is the way to go.



**CYGNETT PARADOX
TEXTURE & SLEEK**
\$49.95 (SLEEK) \$59.95 (TEXTURE) | WWW.CYGNETT.COM

The Paradox cases are built from a solid snap-on back and heavily folded front folio case, which gives it a certain amount of flexibility when it comes to viewing angles, because there's multiple ways you can fold its front cover down to create different angles. Not all angles will work and support even the relatively light weight of the iPad Air, however, although it is somewhat fun to muck around with. The Textured variant costs a little more, but beyond style the embedded texture gives it slightly more grip when closed. The Paradox is a nice thin case, but the flipside there is that it's not the most protective of units.

Verdict



LIFEPROOF FRÉ
\$119.95 | WWW.LIFEPROOF.COM

Like the Nüüd case, Lifeproof's Fré offers a complete protection solution for tablets, and like most rugged cases there's a tradeoff there in that actual installation is a fairly involved process. This isn't a case that comes together or indeed off the tablet easily, which is reassuring from a protective standpoint, but also means that accessing ports and buttons is a serious chore. Unlike the Nüüd the Fré does have a front covering panel of material which affords it a bit more drop protection. The Fré is still quite thin for a protective case, but you'll feel the extra heft, especially on an iPad Air.

Verdict



Verdict



Verdict



LOGITECH HINGE

\$69.95 | WWW.LOGITECH.COM

The Hinge is a regular folio case with one specific selling point that its name pretty much defines. It has a very stiff hinge that Logitech claims allows for up to 50 degrees of angle choice when putting it in landscape mode. It works quite well, although that does feel a little gimmicky, because the reality, whether you're using the Air or Mini version of the case is that you're only ever likely to use one or two angles at best. The outer layer is a simple fabric in a choice of two tones, and the front cover supports magnetic power switching.



TECH21 IMPACT MESH

\$39.99 (MINI)/\$49.99 (IPAD) | WWW.TECH21.COM

For protective cases, Tech21's Impact Mesh cases don't do a whole lot to protect the front of either an iPad or iPad Mini. That's not the point, however, as they're designed to work with iPad owners who already have Apple Smart Covers, with ridges cut out of their solid cases to accommodate the magnetically attached covers. Tech21's protection comes about due to a thin layer of shock absorbent orange material on the edges that should prevent heavy drop damage. The iPad version of the case is otherwise entirely clear, while the iPad Mini version adds a distinct blue hue to your tiny tablet. They're solid if you've already got a smart cover, but otherwise the total cost would be rather high.

Verdict



IPAD MINI

LIFEPROOF NUUD

\$129.95 | WWW.LIFEPROOF.COM

There's protective cases that cover you for simple drops, and then there's a whole separate range of cases that have specific IP ratings for such matters if you're working in environments that are less than technology friendly. Lifeproof's Nuud case is IP68 rated for water and dust ingress, but unlike many ruggedised cases, does so without putting a film over the front screen, which means the iPad Mini within remains very responsive, albeit not actually drop-proof from the front. It's not cheap, but if you know your iPad Mini's going to live outdoors a lot, it could be a very sensible investment.

Verdict



TARGUS EVERVU CASE

\$39.95 | WWW.TARGUS.COM.AU

The Evervu case has one of the simplest holding mechanisms we've seen in a folio case, with a single tiny strip of elastic holding the top right corner of the folio shut. On a larger case that probably wouldn't work, but on the smaller iPad Mini it does a serviceable job keeping the case shut. Targus reckons the Evervu, which is also available for larger iPads and selected Galaxy Tab 4 models has "infinite" viewing angles, but we'd suggest they buy a dictionary, because "infinite" ends up being essentially two; either with the folio folded behind Smart Cover style, or propped up on the inside of the folio front cover.

Verdict





OTHER COVERS

LOGITECH FOLIO

\$79.95 | WWW.LOGITECH.COM

Logitech makes its basic Folio case for a wide variety of tablets; we were sent cases for the iPad Air and three different sizes of the Galaxy Tab 3.0 (7.0/8.0/10.1-inch) to evaluate. They're all functionally similar, with magnetic clasps that also act as on switches for their relevant tablets, a simple but secure plastic frame to hold the tablet in place that tilts out for a single viewing angle. While it's simple, it's quite robustly built without being bulky.

Verdict



TARGUS UNIVERSAL ROTATING FOLIO STAND

\$49.95 | WWW.TARGUS.COM.AU

As its name suggests, the Universal Rotating Folio Stand isn't a specifically designed case for a particular tablet type. Instead, four elastic clips hold a 9-10-inch tablet in place. The only real issue there is that the elastic parts may sit over some ports depending on tablet type; for a test iPad Air we had to shuffle them a bit to get to the headphone port. The back of the case rotates in a rather stiff fashion, allowing for portrait mode viewing as well, giving it plenty of flexibility for multiple uses. It's not as specifically tailored as most cases, but that's arguably a plus, as it's a case you could use with multiple tablets as you upgrade over time.

Verdict



TARGUS VUESCAPE CASE

\$49.95 | WWW.TARGUS.COM.AU

Targus' Nexus 7 specific case offers standard folio-style protection with a solid clip style clasp at the side to keep the case shut. Open it up, and it folds out to allow potentially up to five different viewing angles, although like most cases there's a bit of extension at the most extreme angles. You're not exactly spoiled for choice when it comes to Nexus 7 specific cases, and it should be noted that the specific cut of this case means that original Nexus owners are out of luck, but if you want to protect your 2nd Generation Nexus, this is a very solid option.

Verdict



CYGNETT CACHE FOR GALAXY NOTE 8.0

\$49.95 | WWW.CYGNETT.COM

This model-specific hard tablet case is, as you can probably guess, intended for Samsung's 8-inch Note tablet. Though there's an iPad version of the Cache, this Note edition is actually a little different — and arguably superior — to its Apple counterpart. It's a tough plastic case with a front flap that's secured in the middle of the back — this means that it can act as a stand to prop your tablet up. It's made nice a grippy on the outside thanks to a faux denim effect (available in grey or red) and the Note 8.0 fits snugly inside with ample room to get to ports and buttons and that all-important stylus slot. On the inside of the screen cover there's a couple of card-holder slots — although we found these to be a bit of a tight fit and they'll only hold one or two cards. So why's the Note version of the Cache better? It actually has grooves to hold the Note 8.0 at three different angles. If you've got one of these older Samsung tablets, this is a decent option — though it's getting pretty thin on the ground, so it may take some hunting to find it.



Verdict



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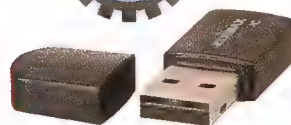
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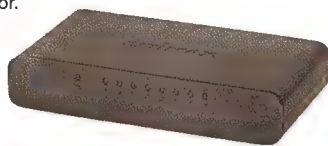
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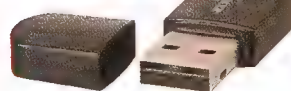
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UNIVERSAL TABLET KEYBOARDS

Keep your screen grease free.
Jenneth Orantia

As a general rule, Bluetooth keyboards can be used with any tablet, offering a convenient, wire-free method of typing on tablets that don't have a USB input. Despite this cross-compatibility, Bluetooth keyboards are designed for one specific platform. All of the standard keys will work across devices, of course, however the proprietary shortcuts and settings mapped to the function keys will only work in their entirety on one platform.

Keyboards with a Start button are obviously designed for Windows machines, while keyboards with Command and Option buttons are designed for Macs. You can also find keyboards that are specifically aimed at iOS or Android users.

Unlike conventional wired keyboards, the design of Bluetooth keyboards can be quite varied. They range from full-sized that replicate the desktop experience to ultra-portable aimed at smartphones. For a tablet, your best bet is something in the middle that's portable enough to carry alongside your tablet in a small bag, but not so compact that it's difficult to touch type on.

Comfort is a key consideration for any type of keyboard. The bigger it is, the larger the keys are, and the more comfortable it is to type on for extended periods. However tactile feedback, which is how the keys feel when you press them, is also important, as is the layout of the keyboard. Many of the smaller keyboards, for instance, save on space by making certain keys — such as the Tab, Shift and Backspace buttons — a lot narrower.

KENSINGTON KEYFOLIO PRO 2 UNIVERSAL

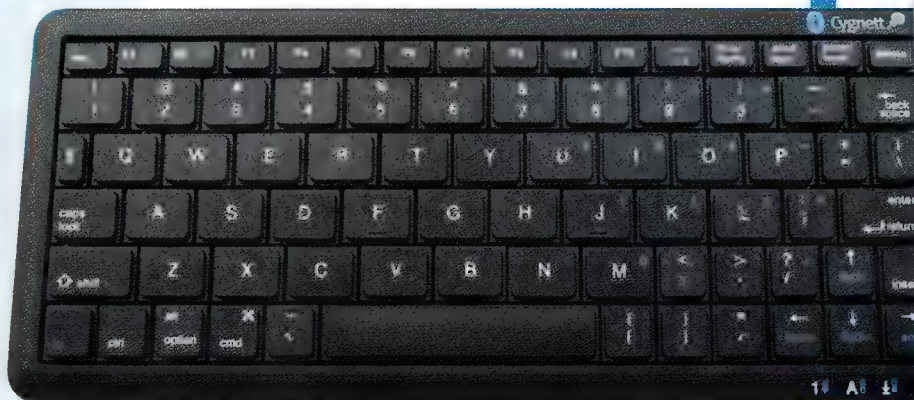
\$99.95 | WWW.KENSINGTON.COM

If you own an Apple or Samsung tablet, there's a good chance you'll find a keyboard case for it from the likes of Logitech or Belkin. Otherwise, you have to make do with one of the universal standalone Bluetooth keyboards.

Kensington offers a compromise with the KeyFolio Pro 2 Universal. This generic keyboard case secures 10-inch tablets using one of two sets of plastic corners that attach to the back of the case with Velcro. Kensington is aiming at the hordes of 10-inch Android tablets on the market, and as such there are plenty of Android-specific buttons such as Home, Menu, Gmail and Browser.

The spacious keyboard offers large keys and good tactile feedback — the only issue is that the complete package more than doubles the weight of a standard 10-inch tablet and makes it about four times thicker.

Verdict



CYGNETT KEYPAD

\$99.95 | AU.CYGNETT.COM

Cygnett takes portability to the next level with the aptly-named KeyPad, which is designed primarily for Mac users. Its small size makes it a great match for 7-inch tablets as it doesn't take up much space in a bag. Length-wise, it's only slightly taller than the Google Nexus 7 at 218mm and about three quarters as long as the keyboard on the MacBook Pro.

As you'd expect with a keyboard this small, there isn't much room to rest your fingers on the keyboard, making it quite cramped to type on. To make matters worse, the key travel is rather shallow, resulting in an unsatisfying typing experience that's rife with errors. To save on space, the Tab key is about a third of the size of a letter key and it ditches the right-hand Shift, Option and Command keys altogether.

Verdict



apc
HOT PRODUCT

LOGITECH BLUETOOTH EASY-SWITCH KEYBOARD KS811

\$149.95 | WWW.LOGITECH.COM

The KS811 is the Apple version of Logitech's excellent KS810. While it's billed as being designed for all Apple devices – including the Apple TV – it's largely geared toward desktop devices running OS X. Function keys for OS X features like mission control and launchpad can be found along the top, and you'll also find the option and command keys on either side of the space bar.

The silver base and black keys makes the KS811 a dead ringer for the keyboard on MacBook laptops, complete with the laser-etched backlit characters on each key. Unlike Apple's own Bluetooth keyboard, it offers backlighting so you can type in low-lit conditions.

The KS811 also includes Logitech's handy Easy Switch feature for typing on different Apple devices without having to go through the hassle of re-pairing the keyboard each time.



Verdict



LOGITECH BLUETOOTH ILLUMINATED KEYBOARD KS810

\$159.95 | WWW.LOGITECH.COM

Logitech's Easy Switch function makes this keyboard remarkably versatile. Three buttons on the top can be assigned to three different devices, making it easy to move between writing a document on your Windows desktop to updating your social status on your iPad to replying to an SMS on your Android smartphone.

The KS810 is mainly designed for Windows, with OS-specific keys such as the Start menu and an app switching button, but it's also compatible with Android and iOS devices. Typing is comfortable with a stylish brushed aluminium finish and laser-etched backlit keys. With battery-saving features like auto-adjusting backlight, motion sensor and auto-off power, the internal rechargeable battery is good for up to a month's worth of use.

Verdict



LOGITECH TABLET KEYBOARD

\$99.95 | WWW.LOGITECH.COM

Logitech's Tablet Keyboard adopts a similar concept to the Microsoft Wedge Mobile, with a keyboard cover that does double duty as a tablet stand. It isn't as innovative as the Microsoft solution, as the cover doesn't transform into a stand so much as open up with a plastic arm connecting the two sides. Build quality doesn't quite match up either.

However the wider, desktop-sized footprint results in a more satisfying typing experience overall, and with versions of the keyboard available for iPads and Android tablets, it offers wider native compatibility than the Microsoft Wedge Mobile. It's just not very mobile. At 288mm, it's longer than most tablets (the iPad Air measures 240mm tall), and it's relatively heavy at 400g with the four AAA batteries inside.

Verdict



MICROSOFT WEDGE MOBILE KEYBOARD

\$99.95 | WWW.MICROSOFT.COM

Microsoft's Wedge Mobile Keyboard is quite clever, pairing a compact Bluetooth keyboard with a rubberised cover that doubles as a tablet stand. Taking the cover off automatically powers the keyboard on (and vice versa), and it bends in the middle to prop up tablets of any size.

The main goal with this keyboard is portability. Microsoft hasn't wasted any space, cramming all of the keys into as small a space as possible. The keys themselves are a good size and offer better-than-average tactile feedback, but since there's no space between each key, it amounts to a cramped typing experience.

Compatible with iOS and Android devices, it shines when paired with a Windows 8 tablet thanks to the dedicated charm buttons and traditional Windows functions.

Verdict



UNIVERSAL STYLUSES

Get to the point with
Jenneth Orantia.

When Apple launched the first iPhone back in 2007, it changed touchscreen input forever. By replacing the predominantly stylus-based input of previous mobile devices with a user experience that relied completely on the human touch, it relegated the humble stylus to the dusty corners of mobile computing history.

In recent years, however, there has been a move back towards stylus input. As tablets have become more adept as content creation devices, styluses have made a big comeback, offering far more precision for writing and drawing than the human finger.

While touch has been and always will be the most intuitive way to navigate a mobile device and perform actions like web browsing and photo scrolling, styluses designed specifically for the capacitive touchscreens found on modern tablets offer a more accurate experience for fine detail work like handwriting and sketching.

Not all styluses are created equal. Some are geared toward drawing rather than writing, some include a built-in ball pen for convenience, while others swap the standard rubber nib at the end for silicone or plastic.

There are even tablets that now offer stylus functionality baked into the touchscreen, such as the Samsung Galaxy Note 10.1 and the Microsoft Surface Pro. Unlike regular tablets, these devices have Wacom 'Feel IT' technology built-in that recognises input from specially designed styluses. The main benefit of these types of tablets is that they support pressure sensitivity, which means the lighter you press on the screen, the finer the lines appear.

KENSINGTON VIRTUOSO TOUCH STYLUS & PEN

\$29.95 | WWW.KENSINGTON.COM

The Virtuoso Touch Stylus & Pen offers a good balance between price and functionality. Its touchscreen input doesn't stand out per se, however the high quality construction and the fact that it doubles as a premium ball point pen (complete with the ability to use Parker pen refills) makes it a cut above other styluses in its class.

Thanks to the dark grey colouring and chrome accents, the Virtuoso would look right at home in an executive boardroom.

It also feels nice and weighty in the hand, with the same size and length of a traditional metal-bodied pen. Whether you're using the silicone nib at one end or the ball point pen at the other, you'll get a good writing or drawing experience from Kensington's two-in-one Virtuoso.



Verdict



ADONIT JOT FLIP

\$49.95 | WWW.ADONIT.NET

Adonit's unique design ditches the standard rubber nib for a metal tip connected to a clear disc. It's an odd pairing that takes a little getting used to, as you're essentially tapping against your tablet screen with another flat surface. Moreover, it makes a dull clack whenever it hits the screen.

If you're after a high degree of accuracy, however, the Jot Flip is second to none. The tip itself is more precise, as the touchscreen only registers input from the fine metal tip. You can also see through the Jot Flip's plastic disc to see what you're writing.

It's pricey compared to other styluses, but the precise input paired with the high-quality aluminium construction, built-in ball pen and magnetic attachment (compatible with certain tablets like the iPad and Surface Pro) makes it well worth the outlay.

Verdict



WACOM BAMBOO STYLUS FEEL

\$49 | WWW.WACOM.COM

The Bamboo Stylus Feel is compatible with tablets that use Wacom's 'Feel IT' technology, such as Samsung's Galaxy Note range of devices and the Microsoft Surface Pro. This uses EMR (electro-magnetic resonance) signals to communicate with a special sensor built into the tablet. As a result, it offers much greater precision than a capacitive stylus and supports features like pressure sensitivity and palm rejection.

Compared to the stubby stylus included with the Samsung Galaxy Note 10.1, the Bamboo Stylus Feel is a marked improvement. It's about the same length as a standard pen, and with the pen cap clipped onto the other end, it has a comfortable and well-balanced feel to it. The only real downside is that it's only compatible with a small subset of tablets, and this doesn't include the popular iPad range.



Verdict



BELKIN MIXIT STYLUS

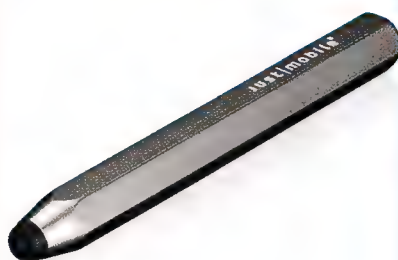
\$12.95 | WWW.BELKIN.COM/AU

The Belkin Mixit Stylus is about as simple as capacitive styluses get. Save for the eight colours that it's available in (including pink, purple and light blue) it's almost completely frill-free — a fact that's reflected in its bargain pricetag.

Compared to the other styluses on test, it's a lot shorter and lighter. It's even smaller than the stylus that comes with the Samsung Galaxy Note 10.1, although it's heavier as well. One value-add it does offer is the chrome clip, enabling you to attach it to a shirt pocket or tablet case.

As far as the stylus input goes, the Mixit is fairly average. The rubber nib glides smoothly over the screen with just the right amount of friction, however it has a larger circumference than normal, making it a little harder to write or draw precisely on the screen.

Verdict



JUST MOBILE ALUPEN

\$29.95 | WWW.STREETWISE.COM.AU

If the standard-looking styluses aren't inspiring your creativity, the Just Mobile AluPen may be just the ticket for getting you into that artistic mood. Fashioned to look like a stylish artist's pencil, the AluPen is a lot chunkier than its contemporaries, constructed from high-quality aluminium with a soft rubber nib at the end. It also comes with a fake leather carrying case.

As funky as it looks, however, we're not convinced that it's all that practical for everyday use. The wider girth makes it uncomfortable to use for extended periods, while the oversized nib makes it difficult to draw fine lines accurately and see what you're doing on the screen. For handwriting especially, the AluPen makes for a poor choice compared to the identically-priced Kensington.

Verdict



WACOM INTUOS CREATIVE STYLUS

\$99 | WWW.WACOM.COM

iPads may not have the 'Feel IT' technology that a handful of Android and Windows 8 tablets do, but if you're happy to part with a hundred bucks, you can get the same pressure sensitivity and palm rejection features through this stylus.

It pairs a standard rubber nib (usable with any capacitive touchscreen) with Bluetooth Smart technology, the latter of which communicates with supported iPads (iPad 3, iPad 4, iPad mini and later) to enable the Feel IT-like functionality.

There are however, a couple of catches. The extra features only work with a dozen or so iPad apps that have been specifically coded to support the stylus, and while the rubber nib makes it compatible with all tablets, it's nowhere near as precise as the plastic tip on the Bamboo Stylus Feel.

Verdict



CHARGE YOUR TABLET ANYWHERE

Portable power banks are a neat way to juice up your gadgets while you're out and about. Lindsay Handmer tests five large-capacity models built for charging tablets.

Small power banks are great for charging up a phone, but to juice up a power hungry tablet such as the Google Nexus 10, a 10,000 mAh or larger capacity is necessary. Anything less won't give a full charge, though an iPad with its smaller battery will get a charge and a half from the same capacity power bank. We tested real world capacity when supplying 2.1A (as needed for a tablet) charging a single device. Due to inefficiencies in the circuitry and charge process, you won't get the full rated capacity of your power bank in real world use – but many come very close. When using a high capacity power bank you can expect to charge a smartphone and tablet at the same time, or two tablets for the better models. It's worth noting these size power banks are often not that much physically larger than lower capacity 5000 mAh models. When recharging the power bank itself, for best results use a 2.1A tablet charger, as a normal phone charger or USB port will be a lot slower. While they look tempting, avoid the very cheap yet supposedly very high capacity (20,000 or 30,000 mAh) power banks, as these are typically fake capacities. If you use your power bank very heavily (fully discharge every day), it can be worth going for a more expensive, higher quality model as these typically use better battery cells and will last longer. For occasional use cheaper models can offer great bang for buck.

KOGAN UNIVERSAL 11000 \$59 | WWW.KOGAN.COM.AU

With a huge 11,000 mAh capacity, this power bank is designed to juice up even your hungriest of devices. Tested real world capacity is good, with 94% available – enough for a full tablet charge. The 2.1A USB port can produce up to 2.2A, and you can charge a tablet and phone at the same time (though not two tablets) thanks to the second 1A port. The Kogan power bank comes with Mini and Micro USB plugs, plus old school Nokia and flat Apple connectors. At 171 x 75 x 24mm, it's small, yet chunky and weighs 349g, so is much better suited to a bag than slipping into a pocket. You can only buy the Kogan online, so factor shipping into your final cost.



Verdict



COMSOL POWER BANK 11000 \$79 | WWW.OFFICEWORKS.COM.AU

With a large 11,000 mAh battery, the Comsol has an impressive 97% of the available capacity. This means you can charge your smartphone 4 or more times, or fully recharge a tablet. It also handles a higher charge rate from your tablet charger, meaning you can fill it back up in under 9 hours. The Comsol features 2 USB ports and while only one is rated at 2.1A, in our testing both could supply enough power to charge a tablet – even with two plugged in at once. While slim, the side mount USB ports mean you can't easily have it charging and in your pocket. On the plus side the Comsol has a built in LED torch that will literally run for over a week straight.

Verdict





MOSHI IONBANK 10K

\$139.95 | WWW.MOSHISTORE.COM

With 96.5% of the 10,000 mAh capacity usable, the IonBank can just squeeze a full charge into your Nexus 10, but won't quite top off your Nexus 5 four times. The lower capacity iPhone and iPad batteries fair better, with 6 and 1.4 full charges respectively. The IonBank has a compact (123 x 80 x 25mm) yet quality aluminium and plastic shell with a slide off cover hiding a mini USB plug. It's also got a 2.1A USB port and will happily charge two tablets at once. The IonBank features a built in USB charging cable, but the rate is a little slower than most and it does not seem to want to charge faster than 1.1A, meaning it takes over 10 hours to top back up.

Verdict



ROMOSS SENSE 4

\$32.95 | WWW.TECHONI.COM.AU

Not exactly one of the brand names you know, the Romoss Sense 4 is an OK quality power bank that is common at your local computer store or on eBay. It's dead cheap but there is a catch – out of the 10,400 mAh available, only about 78% are usable. The culprit is probably lower quality circuitry and batteries, as when we use a less intensive 1.1A discharge, we eke out 85% of the capacity. It has two USB ports but only one can supply 2.1A. Fortunately it's got a nice fast recharge time and fills up in just over 7 hours. While the Romoss Sense 4 is undoubtable of lesser quality than its competition here, the capacity to dollar ratio is very good.

Verdict



VERBATIM DUAL USB POWER PACK

\$60 | WWW.VERBATIM.COM.AU

While Verbatim might be an unexpected name to be producing a power bank, the resulting product is very good. The 10,000 mAh capacity is 97.5% accessible, meaning you can charge even the most power hungry tablets from dead flat or top up your phone many times over. The unit is built thin at just 12mm and is very portable. It's got dual USB ports and while only one is designated for charging tablets, we found the 1A port could just scrape up enough power to charge at 2A. It can accept a higher charge current from your 2.1A tablet wall charger, but will still take almost 9 hours for a full charge. Make sure you shop around for the Verbatim as there is up to a \$40 price difference online.

Verdict



REAL WORLD TEST RESULTS

	CHARGE TWO TABLETS SIMULTANEOUSLY	CHARGE TIME (HOUR:MIN)	LISTED CAPACITY (MAH)	USABLE CAPACITY (MAH)	USEABLE CAPACITY %	GOOGLE NEXUS 10 RECHARGES	IPAD RECHARGES
KOGAN 11000	NO	9:11	11,000	10,364	94.21	1.2	1.5
COMSOL 11000	YES	8:46	11,000	10,674	97.04	1.2	1.6
MOSHI IONBANK 10K	YES	10:19	10,000	9,651	96.51	1.1	1.4
ROMOSS SENSE 4	NO	7:14	10,400	8,127	78.14	0.9	1.2
VERBATIM DUAL USB	YES	8:39	10,000	9,757	97.57	1.1	1.4

BLUETOOTH SPEAKERS

Cranks some tunes, Jenneth Orantia checks out some portable speaker units for your tablet.

The built-in speakers on tablets are generally lot better than the ones found on smartphones, as vendors can fit larger drivers and space them out more for stereo sound. However you'll still get significantly better audio if you pair your tablet with an external speaker. If you can stretch your budget to a Bluetooth speaker, you'll get a better experience still, as you won't have to fuss around with wires every time you want to use it and you can control music playback from your tablet while the speaker is across the room.

There are plenty of things to consider when shopping for a Bluetooth speaker. Portability is an obvious requirement: ideally it should be as small as possible so as not to take up too much room in your backpack or handbag. However this needs to be countered against the fact that smaller speakers aren't capable of delivering the same audio performance as their larger counterparts.

If you'll be using the speaker outdoors on a regular basis, durability and sound output are also things to keep in mind. Speakers that offer splash- and dust-resistance make for great companions at beaches and BBQs, however bundled cases can also keep your speaker safe from the elements. The speaker will also need to be loud enough to hear above the ambient noise outdoors – all the more so if you're at a social gathering where there's lots of chatter and laughter (hopefully) to contend with.

BOSE SOUNDLINK MINI

\$249 | WWW.BOSE.COM.AU

The Bose brand is synonymous with best-in-class sound quality, and the SoundLink Mini hasn't cheapened the company's reputation any. Despite its compact frame, it delivers a louder, fuller and bassier sound than any of the other speakers on test, including the UE Boom.

The UE Boom and SoundLink Mini both have two passive radiators and two dynamic audio drivers, however the clever engineers at Bose have managed to wring more out of this tightly-packed arrangement, delivering an incredibly punchy bass performance that doesn't overwhelm the mid-range or treble.

That said, the UE Boom is still the better match for tablet users due to its lighter weight (the Bose weighs a solid 680g), sporty, splash-proof construction and more than twice the battery life. It's also fifty bucks cheaper.



Verdict



LOGITECH UE BOOM

\$199.99 | WWW.LOGITECH.COM

The 'Boom' in Logitech's UE-branded speaker isn't an exaggeration. This portable speaker really packs a punch for its size, delivering clear, room-filling audio and satisfying bass that sounds great across a variety of music genres. It's heavier than the similar-looking Sony SRS-BT550, but it also has a bigger battery, lasting for up to 15 hours per charge. It's also water-resistant.

We like the uncluttered yet attractive design of the UE Boom. If you buy a second UE Boom (or have a friend that owns one), you can wirelessly connect the two for stereo sound, although it doesn't use the built-in NFC to link them like the Beats By Dre Pill 2.0 – you have to enable this manually through the UE Boom app.



Verdict

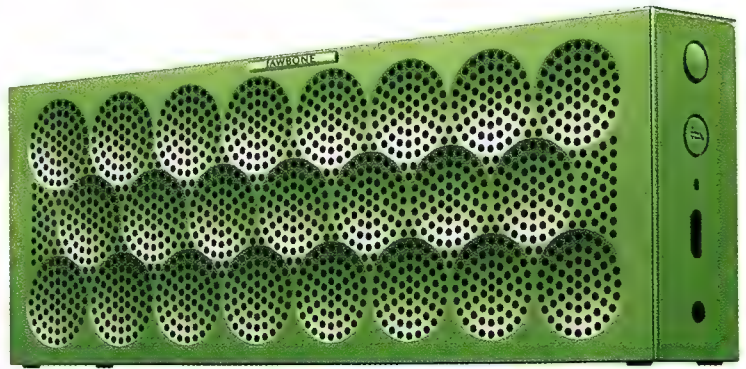


JAWBONE MINI JAMBOX

\$229 | JAWBONE.COM

The original Jambox set a new benchmark for portable Bluetooth speakers, providing Hi-Fi-quality audio in a relatively small form factor. However it was still large compared to other systems. The Mini Jambox doesn't have this issue. At nearly half the size of the Big Jambox, it's small enough to slip into your back pocket while offering the same stunning anodised aluminium casing and various colour and grille design options.

Of course, the small size means it lacks the power of its big brother. The Mini Jambox's main shortcoming is that it isn't very loud, which rules out bringing it anywhere where there's a lot of ambient noise. It performs best as a personal speaker playing simple acoustic tracks with vocals and string instruments.



Verdict



BEATS BY DRE PILL 2.0

\$259 | AU.BEATSBYDRE.COM

Audio products stamped with the Beats By Dre brand are well known for exaggerating bass response, making them all the better for listening to the thumping hip-hop tracks of their namesake. Surprisingly, the Beats By Dre Pill 2.0 doesn't go down this route.

It's certainly loud enough to drive a party, but it distorts at top volumes and the bass performance leaves a lot to be desired. Vocals and instruments also lack the detail we'd expect in a speaker of its class.

Most of the pricetag, it seems, goes towards the Pill's distinctive design, and the eye-catching metal cylinder – available in seven different colour combinations – and exposed speaker drivers certainly make it look the part. Unlike its similarly stylish counterpart the Jawbone Mini Jambox, it also comes with sturdy hard-shell carrying case and wall adapter.

Verdict



HOUSE OF MARLEY CHANT

\$99.95 | WWW.THEHOUSEOFMARLEY.COM.AU

Everything about the Chant is environmentally conscious, from the canvas case, constructed from hemp, organic cotton and recycled plastic bottles, to the recycled plastic housing and packaging. It's a good-looking speaker, but it actually looks better inside the case. Don't let the bamboo ring at the top fool you – the rest of the speaker is nondescript black plastic.

Of course, reducing your carbon footprint probably isn't high on your list of priorities when choosing a speaker, and sadly, House of Marley doesn't really back it up with decent sound quality. Even taking into account its relatively affordable pricetag, the Chant doesn't deliver the goods, producing tinny, muffled sound that distorts quite noticeably at louder volumes. Despite the use of a passive bass radiator, the bass is weak as well.

Verdict



SONY SRS-BTS50

\$179 | WWW.SONY.COM.AU

This looks and works a lot like the Logitech UE Boom, between the cloth-covered wrap-around grill, multiple colour options, cylindrical design and splash-proof construction. Both of them also have built-in NFC to reduce the Bluetooth pairing process to a single tap on compatible devices.

But they're not identical. The SRS-BTS50 has some extras, such as two sound modes that automatically change depending on how it's sitting (uni-directional when on its side and simulated surround-sound when upright) and an audio output for connecting headphones or an external speaker. It's also lighter at 400g.

When it comes to performance, however, the Sony pails in comparison. It doesn't get as loud as the Logitech, making it more suitable for personal listening rather than parties, and the sound isn't anywhere near as clear.

Verdict



GAME CONTROLLERS

Take your tablet gaming to the next level with a gamepad. Alex Kidman

Mobile gaming is a huge market worth millions of dollars. Which is great if you're a software developer, but there's a notable problem if you're a heavy gamer, because controlling a character via touch screen can be downright annoying. Some games manage this better than others, but anyone who likes action titles will inevitably hit a point where touch just isn't good enough.

That's where dedicated mobile games controllers are meant to come in. Not every title supports them, but if your mobile gaming aspirations go just a little further than *Flappy Bird* then a mobile games controller can make sense, although as we've found, few of them are particularly wallet friendly.



Use your existing controllers with Android

With the exception of the Moga controller, dedicated games controllers for smartphones and tablets are expensive little critters, especially compared to the cost of a console controller. The good news there is that if you're an Android user with a PS3 or Wii, you've already got a controller that'll work with a number of Android games titles.

The beauty of Android being open is that there's a lot more room to hack and use alternate devices. You can use an official PS3 controller with Android with little more than a USB OTG controller if your device isn't rooted, or with the \$2.43 Sixaxis Controller app if it is. Installation is a matter of generating the Bluetooth Address for the controller from a complimentary PC/Mac app, then inputting that address into the Sixaxis app before finally setting it as the input method of choice.

Connecting a Nintendo Wiimote to Android is even simpler in theory, with apps such as Wiimote Controller giving simple Bluetooth pairing. The issue here is that the Bluetooth synchronisation method used for Wii controller pairing works well with older Android devices, but anything newer than Android 4.2 has sketchy connectivity at best. Wiimote Controller is a free app that doesn't require root, however, so you're risking very little seeing if it will work for you.



MOGA POCKET ANDROID CONTROLLER

\$29.95 | BLUEMOUTHDIRECT.COM/

Moga's Pocket Android controller works via its own Moga Pivot App, which also acts as a store for Moga-compatible games. What's nice here is that it'll automatically detect any compatible installed games already on your system, so you don't end up buying twice.

The Moga is a fairly simple pad with a fold-out arm to hold an Android phone in place, similar to the Samsung Gamepad, although you can just pair it to a larger Android tablet as well. Response was good across most titles we tested with, although the small face buttons are just a little bit sticky at times. Like most other mobile controllers, the Moga doesn't work with every game title, and that's a pity, but it's mitigated strongly by its relatively low asking price.

Verdict





STEELSERIES STRATUS

\$99.95 | WWW.STEELSERIES.COM

The SteelSeries Stratus offers a lot more button and input control than competing MFi controllers, and while it's quite small, if you're already au fait with, say, the standard Xbox layout you'll find it easy to pick up and play a wide variety of game titles.

A cover is provided for transit. It also clips onto the back if you want to expand the size of the SteelSeries Stratus.

There are some issues to contend with, however. While it's technically compatible with iOS 7 devices, that's a list limited to iPhone 5/5s/5c, iPad Air/4th Gen/Mini and 5th Generation iPod Touch. It'll pair with a third generation iPad, as we found, but then drop the connection or refuse to work in compatible games, which is annoying.

It's also not cheap, and that's undeniably a big drawback for a peripheral you're not going to use for every game.



ION iCADE

\$99 | WWW.IONAUDIO.COM

The iCade started its life as a ThinkGeek April Fools' Day joke, made into a real product. That meant that once it was real it rather spurred the development of physical controls for mobile devices, and the inclusion of code within games to support it.

The issue here is that the iCade isn't MFi certified, and that means that most of the games that support the iCade tend to be on the older side. It does make a solid MAME cabinet for the jailbroken crowd, or those who've downloaded MAME during the brief periods where Apple's inadvertently made it available. There's simply nothing comparable on a mobile scale if you're an old-school arcade fan quite like the iCade, but at the same time that makes it rather a niche product, and one that's not exactly portable in any real way either.

If you're an old school retro fan, the inclusion of hard hitting buttons and a cherry red joystick will hit you in the tingly nostalgia parts, but if you're more keen on recent fare then an actual MFi controller might be a wiser bet.



LOGITECH POWERSHELL

\$129.95 | WWW.LOGITECH.COM

Playing games is the easiest way to sap your iPhone's already small battery, so the approach that Logitech takes with the Powershell has some merit.

It's a gaming enclosure for an iPhone that also includes a 1,500mAh battery, giving you more gaming time in theory. We say in theory though because comparatively the Powershell is a lesser gaming tool. There's only one directional pad on offer, which means it's poor for titles such as *GTA: San Andreas*, and it is by its nature very large indeed, reminiscent of the Nokia N-Gage if you do have to take a call mid-game. It's also the most expensive controller option we've looked at, and given its high asking price, that makes it a poor choice.

Verdict



Verdict



Verdict





4K IS HERE

ULTRA HD IS THE NEXT-GEN PC RESOLUTION — HERE'S WHY
JOSH NOREM SAYS YOU HAVE TO HAVE IT.

Dream Machine 2013 had some bitchin' hardware, but most of it was available at retail for any well-heeled hardware hound. One part, though, was not: its glorious 4K monitor. You see, 4K was an other-worldly resolution back in

mid-2013, simply because it offered four times the resolution of 1080p — at a wallet-busting expense of \$3,500 of course.

As we enter 2014, though, 4K is now available and affordable, and all modern games support it, making it

one hell of an upgrade. Over the coming pages, we'll tell you all about 4K, show you what you need to run it at its maximum output, and explore 4K gaming benchmarks, too. But as sweet as it is, it's not for everyone, so read this guide before making the move.

The ASUS PQ321Q is 4K for the ballers, with its IPS 60Hz panel and a price tag of \$3,499.



WHAT IS 4K?

A SLIGHT MISNOMER, BUT CATCHIER THAN ULTRA HD.

To put it simply, 4K doubles the standard 1,920 x 1,080 resolution both vertically and horizontally to 3,840 x 2,160, which is quadruple the pixels. We can already see you folding your arms and scanning the page for a downvote button, saying, "That's obviously not true 4K. It only sums up to 3,840 pixels." "True" 4K resolution is a term used in the movie industry. When you hear about movies being shot in 4K, they're typically shot at 4,096 x 2,160 with an aspect ratio of 17:9. On the PC side, we generally run with television makers, who have mostly settled on a resolution of 3,840 x 2,160, which uses the same 16:9 aspect ratio as 1080p. Despite this being far short of 4,000 pixels horizontally, television and monitor makers have all settled on 4K as the term to push, rather than Ultra HD. In other words, we don't make up the buzzwords, so hate the game, not the player.

In a historical context, 4K is simply the next rest stop along the path of technological progress. Way back in the day, we ran our displays at 640 x 480, then 800 x 600, then 1,024 x 768, and then 1,280 x 1,024, and so on. As graphics cards became more powerful, we were slowly able to bump up our display resolutions to where they are now, which for a large majority of gamers is 1,920 x 1,080, or 1080p. Society has settled on 1080p as the go-to resolution right now, simply because those monitors (and TVs) are very affordable, and you don't need a \$500 graphics card to run today's games at that resolution.

Not everyone is average, though. Many enthusiasts today run 27-inch or 30-inch monitors at much higher resolutions of 2,560 x 1,440 or 2,560 x 1,600, respectively. That may seem like a step up from 1,920 x 1,080, but a GeForce GTX 780 Ti or Radeon R9 290X isn't even stressed by 2,560 x 1,440 gaming. Factor in PCs with multiple GPUs, and you start to wonder why we've been stuck with 2,560 x 1,600 for more than seven years, as everything else has leapt forward. We won't question that wisdom, but we do know that it's time to move on, and 4K

is that next step. Looking ahead, the industry will eventually move to 8K, which quadruples the pixels, and then 12K, and so forth. In fact, some vendors already demonstrated resolutions way beyond 4K at CES 2014, including Nvidia, which ran three 4K panels at 12K using four GTX Titans in SLI. For 2014 and beyond, though, 4K is the new aspirational resolution for every hardcore PC gamer.

IT'S ALL ABOUT THE PIXELS PER INCH

You know how every time we pass around the sun once more and it's a new year, people joke about their "New Year's Resolution" being some sort of super-high monitor resolution? Well, we do it, too, because as hardware aficionados there's always room to grow and new boundaries to push. We want our hard drives to get bigger right alongside our displays, so the move into 4K is something we have been looking forward to for more than a year; as resolution scales up, so does the level of detail that is rendered on the screen. The official term for this spec is pixels per inch, or PPI, and it's a good bellwether for how much detail you can see on your display.

To see how PPI varies according to screen size, let's look at a few examples. First, a 24-inch 1,920 x 1,080 display sports roughly 91 pixels per inch. If you bump up the vertical resolution to 1,200 pixels (typical on some 16:10 ratio IPS panels), you get a PPI of 94. If you crank things up a notch to 2,560 x 1,440 at 27-inches, the PPI goes to 108, which is a small bump of about 20%, and probably not very noticeable.

Moving on to 2560x1600 on a 30-inch panel, you actually get lower density, arriving at a PPI of 100. To put this in the context of a mobile device, the Google Nexus 5 smartphone has a 4.95-inch display that runs a resolution of 1,920 x 1,080, giving it a crazy-high PPI of 445. The iPad's 9.7-inch screen delivers a PPI of 264, and the iPhone 5's PPI is 326 pixels. Clearly, there's a lot of room for improvement on the PC, and 4K is a step in the right direction.



IS 4K 'RETINA'?

First off, you have got some gall to compare a glorious 4K display to a marketing term such as "Retina display."

However, for the sake of argument, we'll humour you. As noted elsewhere, a 4K display can have as many as 185 pixels per inch (PPI), which is almost double what is found in today's 1080p displays. However, the term "Retina" as coined by Steve Jobs is usually more than 200 PPI for a notebook, and more than 300 for a mobile display. You see, a PPI rating's significance all comes down to how close you are to the display. Apple defines a Retina display as having enough pixels that the human retina can't distinguish between them, which is quite easy to pull off at a distance of 16-inches, but much less so at six inches. Therefore, mobile displays, which are held closer to your face, oftentimes have crazy-high PPI ratings. Interestingly, despite being the first to heavily push high-PPI displays, Apple has been out-Retina'd these days. The Samsung Galaxy S5 has a PPI of 432, and the Sony Vivo Xplay sits at an insane 490 PPI. The iPhone, with its rating of 326, actually isn't even in the top ten of high-PPI devices. Still, if you ask the average Joe, he'll say Retina is better. The bottom line: At a far enough distance, everything is a Retina display, because pixels are indistinguishable.

PIXEL PEEPING

Now, let's look at the PPI for a few of these fancy new 4K monitors that are coming down the pike. We'll start with ASUS PQ321Q. With its resolution of 3,840 x 2,160 spread across 31.5 luscious inches, its PPI is a decent 140, a noticeable increase from a 2,560 x 1,600 display. Not enough for you? Dell has a new 24-inch 4K monitor dubbed the UP2414Q that shrinks your icons for you while retaining their sharpness. Still, it has the highest PPI yet for the desktop panel at a skyscraping 185 pixels. Slightly below the Dell is a new ASUS LCD named the PB287Q, which at 28-inches has a modest PPI of 157 pixels. Keep in mind that in some cases, this is a 50% increase in the number of pixels per inch, so when you tally that up across the entirety of the display, it equals quite a few more pixels, which results in a lot more detail that is visible even to the naked and semi-clothed eye.

WHY IT'S A BIG DEAL

Just like going from a 24-inch 1080p monitor to a 30-inch 1600p monitor is a life-changing experience, so is going to a 32-inch or smaller 4K panel. The level of detail you can see on the screen is surprising, and when you fire up *Battlefield 4* for the first time, you'll most likely be staring at the screen with your mouth open, and not just because the server dropped you again.

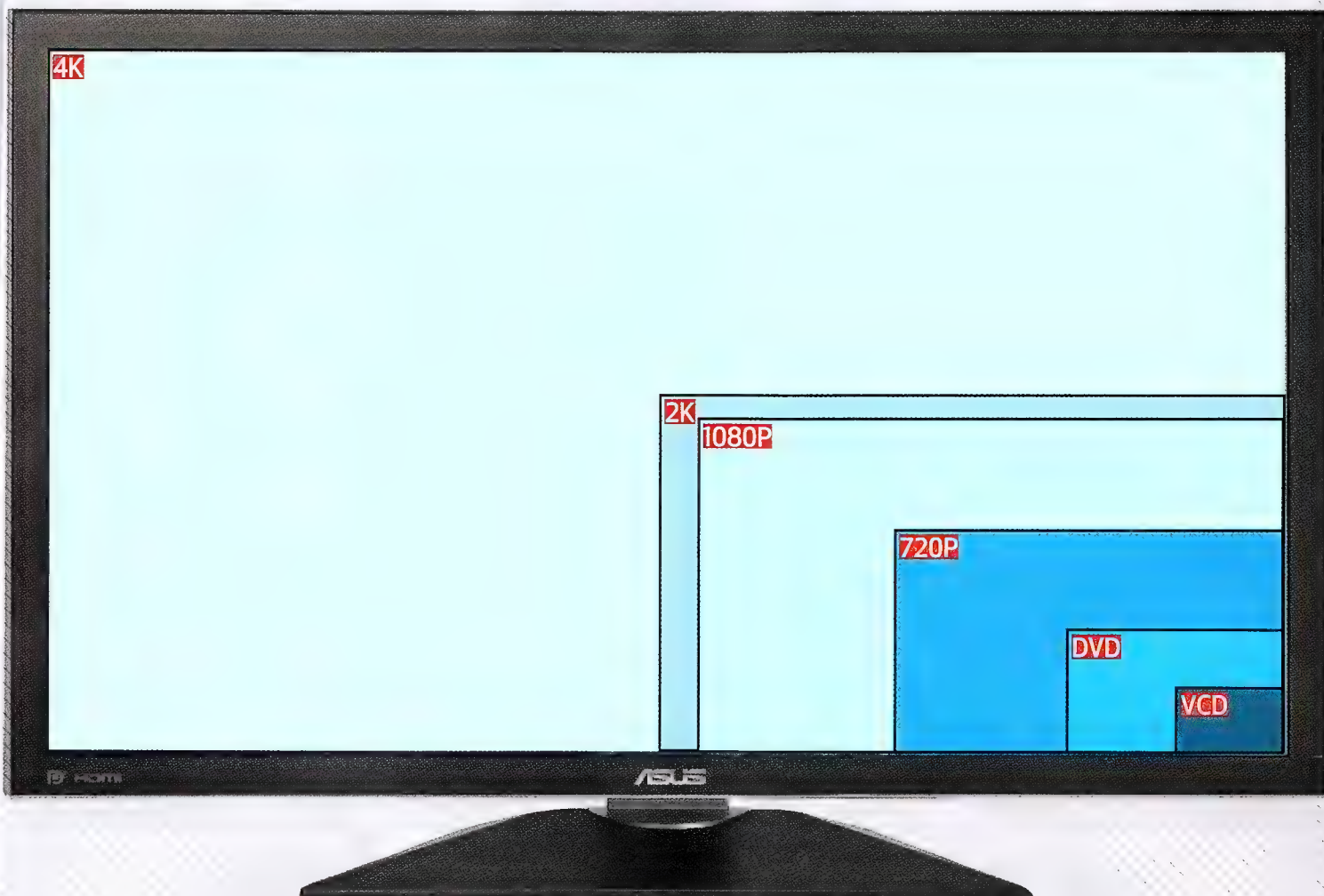
Gaming at 4K looks simply incredible. And unlike television, where there's a dearth of content, almost all PC games support the

resolution, and some developers are even including higher resolution textures now, too.

Of course, both Nvidia and AMD are also pushing 4K because you need one hell of a GPU setup to push those pixels around. Since 4K is still extremely new and not quite ready for prime time, the hardware required to run it is in the same embryonic stage, which translates in layman's terms to "almost there but not quite."

Even a GeForce GTX Titan with its 6GB frame buffer or a Radeon R9 290X and its 4GB frame buffer can barely eclipse 30fps at 4K with all settings maxed. Sure, you can turn down some of the settings and get a flagship GPU to run pretty well at 4K these days, but we'd rather castrate ourselves with a soldering iron than turn down the eye candy.

We didn't spend \$3,500 on a monitor, or have our friends die face-down in the muck, to turn down graphics settings, so we're not budging on that. With all settings turned up, gaming at 4K is truly cutting-edge, and is really the only application that currently stresses today's crop of high-end GPUs, aside from a multi-monitor setup. Today, getting any single GPU to run 4K at the magical 60fps is not possible. There's even a telling statement on the Nvidia web site: "In order to power games at this resolution (4K) with settings turned up, NVIDIA recommends GTX 780 SLI or better."



GO BIG OR GO HOME

FULL HD, ULTRA HD, HD HD — WHAT DOES IT MEAN?

HD 720P

A resolution with more than 700 horizontal pixels was the original "HD" resolution and was used to sell a zillion television sets the world over. On a 1,600 x 900 20-inch display, you get a reasonable PPI of 92.

FULL HD 1080P

After vanilla HD came Full HD, which cranked it up a notch to 1,920 x 1,080 resolution. Full HD is just a marketing term, though, as there's no sanctioning body for HD. Full HD on a 23-inch panel delivers a PPI of 96, so, not much better than HD.

QUAD HD

Though usually not referred to by its proper name, Quad HD refers to a panel featuring 2,560 x 1,440 resolution, which is four times the pixels of HD. A 27-inch panel at this res features a so-so PPI of 108.

ULTRA HD

This is actual 4K resolution, meaning 4,000 horizontal pixels. It is four times the resolution of Full HD, and features a PPI of 144 pixels on a 32-inch panel. The term refers to how professional film is produced and projected though, so it's not really a PC term since PC displays are slightly less than 4K at 3,840 x 2,160.

"Even a GeForce GTX Titan with its 6GB frame buffer or a Radeon R9 290X and its 4GB frame buffer can barely eclipse 30fps at 4K with all settings maxed."

4K CONFUSION CLEARED UP

HOW TO PICK THE RIGHT 4K MONITOR.

It used to be easy to pick a monitor when your biggest decision was choosing between an IPS or TN panel, and your choice at the high end was either 24- or 30-inches. Today, it isn't so easy. Besides the thorny question of whether to choose an IPS model for its superior colour accuracy and off-axis viewing or going with a speedier TN panel, you now have to factor in very high refresh rates, pixel density, resolution differences, and even such technology as Nvidia's new G-Sync. We can't pick for you, but we can help you make your decision.

As with all things in computing, there is no one-size-fits-all product. How much monitor you need depends on your specific usage. Are you a gamer? A content creator? A multi-tasker? On a budget, or a baller like Bill Gates?

For a professional or advanced amateur editing photos or video, the colour accuracy of TN panels still isn't good enough. Today's budget 4K panels, such as Dell's P2815Q or ASUS's

PB287Q, both use TN panels, so pixel peepers will want to move along. The Dell P2815Q also features a major flaw in that its refresh rate is limited to 30Hz at its native resolution. For professionals, the only real answer for now is to go big (and expensive) with the ASUS 32-inch PQ321Q for \$3,499, or go dense with the 24-inch Dell UP2414Q for \$1,449. The ASUS model uses an IPS panel from Sharp with indium gallium zinc oxide (IGZO) to help it pack the pixels so closely. The Dell is also an IPS panel, but other details of the panel technology have yet to be disclosed. Both will hit 60Hz, but you'd better have a gnarly GPU or two if you want to use these panels for gaming. The Dell's pixel density is to die for, with 183 pixels per inch. That's about double that of a standard 24-inch 1,920 x 1,080 panel. There are PC panels that are denser, but not in a desktop form factor. Remember: You'll need bionic vision, too, if you intend to use these monitors without scaling cranked up a few notches, because

windows and icons will look like miniatures — and we're not happy with how Windows scales up right now.

That brings us to the refresh rate debate. For gamers, 60Hz IPS or TN panels are OK, but if you've ever played on a 120Hz panel with a powerful GPU pushing it, you know just how beautifully blur-free they can be. We dare say it, if we gamed more than we edited photos or videos, we'd take a pass on the lowly 60Hz panels. The problem with high-refresh monitors has been their pedestrian resolution of 1,920 x 1,080 in 24-inches. There are 120Hz 27-inch monitors as well, but their 1,920 x 1,080 resolution gives them a remarkably low pixel density of just 81 PPI. ASUS thinks it has the gamer's ultimate fantasy monitor with its new ROG Swift PG278Q. This 27-inch TN monitor has a resolution of 2,560 x 1,440 and a refresh rate of 120Hz. While its pixel density doesn't approach that of a 4K monitor, the 120Hz refresh may compensate for gaming purposes — for hefty GPUs.

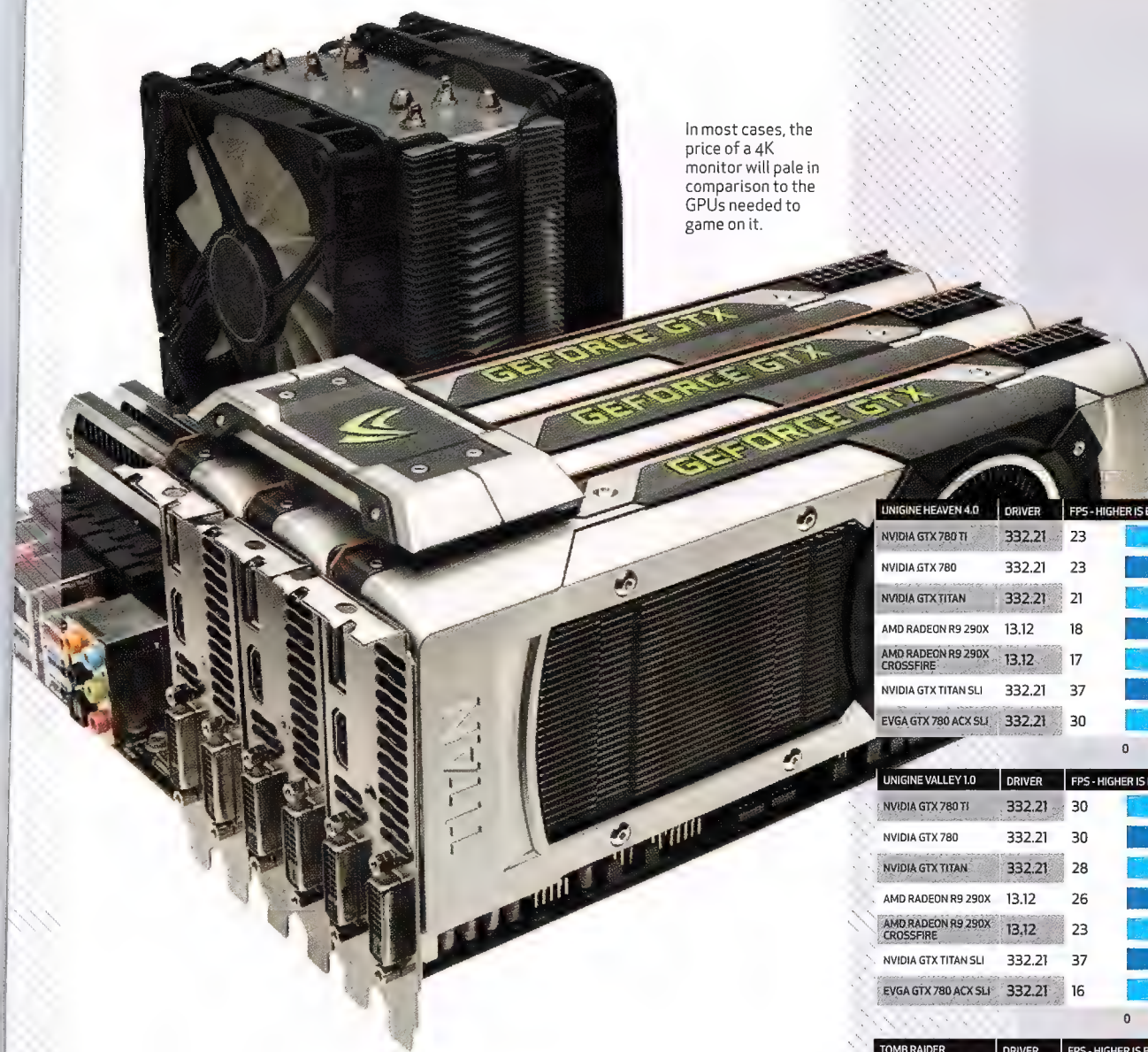
"While its pixel density doesn't approach that of a 4K monitor, the 120Hz refresh may compensate for gaming purposes — for those with hefty GPUs."



The ASUS ROG Swift is the first 2560p monitor with a 120Hz refresh rate.

For those with lesser graphics cards, though, the ASUS Swift monitor also boasts Nvidia's new proprietary G-Sync technology. (The Titan, 7-series, and several 6-series are supported in G-Sync.) This tech syncs the monitor's refresh rate to the GPU's rendering, translating to smoother and sharper images, even if the frame rate dips below 30fps. G-Sync, of course, won't work with AMD cards, but for gamers not hung up on colour accuracy or off-axis viewing, the ROG Swift might be the ultimate monitor right now in the green camp. And yes, we know AMD has talked of FreeSync — the free method to sync refresh with GPU rendering. It's just not clear if FreeSync will work with desktop monitors yet, although it is promising on laptops, which are typically fairly low-powered in the graphics department.

What about a 120Hz panel that also runs at 4K? That's coming too, but remember that you'll need an inordinate amount of graphics grunt to push twice the pixels of a single 4K panel.



In most cases, the price of a 4K monitor will pale in comparison to the GPUs needed to game on it.

Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an ASUS Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8. Our monitor is a 32-inch Sharp PN-K321. All games are run at 3,840 x 2,160 with no AA.

WHAT YOU'LL NEED TO RUN 4K

WE HOPE YOU GET A HUGE TAX REFUND.

YOU'LL NEED NEW CABLES

If you're like us and have been running DVI or dual-link DVI for the past — oh, we don't know, forever? — 4K requires a different connection, as the Digital Visual interface tops out at 2,560 x 1,600 at 60Hz — far short of 4K's needs. To run 4K resolution, you will need to run either DisplayPort 1.2 or HDMI 2.0. For those on the DisplayPort train, version 1.2 is available today and will let you run 4K at 60Hz when using a Multi-Stream Transport (MST) mode. In MST mode, the graphics card generates several signals, or streams, which are combined over the DisplayPort cable in order to run the panel at 60Hz. If you were to use a DisplayPort cable and run the panel in Single Stream Transport (SST) mode, you would top

out at 30Hz. If you're more interested in running HDMI for some reason, it's more complicated. A single HDMI 1.4 connection is only able to hit 30Hz at 4K resolution, which is unacceptable. Some posters on our web site have said "30Hz is fine for porn and web browsing," but we disagree. Just dragging a window around the screen causes it to shear and stutter in a manner similar to how it looks when you run your PC without graphics drivers installed. Some monitors and GPUs allow dual-HDMI connections to achieve the bandwidth needed, but it's a kludge and few support it. The fix for HDMI will come with HDMI 2.0, which will easily allow 60Hz at 4K, as well as multi-channel audio, but no monitor nor any GPU we know

UNIGINE HEAVEN 4.0	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 TI	332.21	23
NVIDIA GTX 780	332.21	23
NVIDIA GTX TITAN	332.21	21
AMD RADEON R9 290X	13.12	18
AMD RADEON R9 290X CROSSFIRE	13.12	17
NVIDIA GTX TITAN SLI	332.21	37
EVGA GTX 780 ACX SLI	332.21	30

UNIGINE VALLEY 1.0	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 TI	332.21	30
NVIDIA GTX 780	332.21	30
NVIDIA GTX TITAN	332.21	28
AMD RADEON R9 290X	13.12	26
AMD RADEON R9 290X CROSSFIRE	13.12	23
NVIDIA GTX TITAN SLI	332.21	37
EVGA GTX 780 ACX SLI	332.21	16

TOMB RAIDER	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 TI	332.21	28
NVIDIA GTX 780	332.21	26
NVIDIA GTX TITAN	332.21	25
AMD RADEON R9 290X	13.12	27
AMD RADEON R9 290X CROSSFIRE	13.12	52
NVIDIA GTX TITAN SLI	332.21	44
EVGA GTX 780 ACX SLI	332.21	44

METRO: LAST LIGHT	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 TI	332.21	19
NVIDIA GTX 780	332.21	17
NVIDIA GTX TITAN	332.21	17
AMD RADEON R9 290X	13.12	18
AMD RADEON R9 290X CROSSFIRE	13.12	29
NVIDIA GTX TITAN SLI	332.21	26
EVGA GTX 780 ACX SLI	332.21	26

BATTLEFIELD 4	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 TI	332.21	40
NVIDIA GTX 780	332.21	36
NVIDIA GTX TITAN	332.21	35
AMD RADEON R9 290X	13.12	38
AMD RADEON R9 290X CROSSFIRE	13.12	64
NVIDIA GTX TITAN SLI	332.21	60
EVGA GTX 780 ACX SLI	332.21	57

"Since 2014 is going to be the year of 4K, it's very likely that whatever is coming from AMD and Nvidia will be better equipped to handle this resolution, and we certainly hope it is."

of currently has the new interface. So, be sure to verify what your panel supports before buying; if you get a 30Hz panel, you will be very, very sorry. And forget about trying to game on that thing.

THE MONITORS

We covered this topic earlier, so we won't go into more detail here, other than to note we're still in the beginning stages of 4K monitor growth. Throughout 2014, you should see 4K panels offered from all the usual suspects. The good news is that prices have already dropped from the \$4,000 mark down to under \$1,000, and we expect many more manufacturers to be offering panels in this lower price range. Whether or not we'll get an affordable 4K IPS panel is a different story. Although, for gaming, TN is fine. The Dell 24-inch IPS panel is relatively affordable — just don't expect to see it hit the \$700ish prices of today's 27-inch and 30-inch panels until at least 2015, if not later.

THE GPUS

If you thought purchasing a 4K monitor was financially painful, you ain't seen nothing yet. That transaction was merely foreplay for the real pain and suffering that will occur when you have to buy enough graphics firepower to run that display at its native resolution on today's games. As we stated earlier, Nvidia itself recommends at least two GTX 780 cards in SLI, so that's \$1,200 worth of GPU, on top of the \$800 to \$4,000 for the monitor. The cheapest way to get into the 4K ballgame at this point would be to buy two Radeon R9 290 cards — assuming you can even find them for sale anywhere — which will set you back \$800. Or you could get two GTX 780s, which will cost you roughly \$1,000. You can pretty much forget about anything less powerful than these \$400 to \$500 GPUs though, as we can guarantee you they won't pack enough of a punch to drive a 4K display to anywhere close to 60Hz. Even the last generation of dual-GPU boards, such as the GTX 690 and Radeon HD 7990, aren't up to the task on their own.

4K BENCHMARKS

Before you look at the benchmark charts in this feature, we recommend that you walk over to your PC and put a blanket over it. Seriously, it doesn't want to see you staring at these benchmark numbers. When you see how incompetent even the most high-end GPUs on the planet are for running 4K, it will probably make your PC seem, well, inadequate. What we mean is, look at these numbers. Even a \$700 GeForce GTX 780 Ti can only hit 23fps in Unigine Heaven 4.0 with everything maxed out, and it hits only 19fps in Metro: Last Light. If there's one takeaway from this benchmark chart, it's this: Most of today's high-end GPUs are still not capable of running 4K at an acceptable level of performance. We're sorry, but that is a fact. Sure, all these games are playable — some more than others — but none of these cards, or combinations thereof, could hit 60fps in any of the games we chose for benchmarking. For this generation of GPUs, this is the reality.

Since 2014 is going to be the year of 4K, it's very likely that whatever is coming from AMD and Nvidia will be better equipped to handle this resolution, and we certainly hope it is. Nvidia's Maxwell GPUs are supposedly on track for a 2014 release, though we probably won't see a flagship board until Q3 or later. The company might also release a dual GK110 board named the GTX 790, but it won't be faster than GTX 780 SLI, so don't get your hopes up.

We've heard nothing about what AMD has up its sleeve, as we expect its Hawaii cards to have a long shelf life. The impending Mantle API update should give the cards a shot in the arm, so to speak. As with Nvidia, though, the current generation is barely capable of running 4K, so we can expect the next-generation cards to be much more capable. The good news is that by the time these newfangled cards arrive, we should have a whole flock of new 4K panels on offer, so it'll be glorious times for well-heeled PC gamers. ■



Our test bed is a 3.33GHz Core i7-3960X Extreme Edition in an ASUS Rampage IV Extreme motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050W PSU. The OS is 64-bit Windows 8. Our monitor is a 32-inch Sharp PN-K321. All games are run at 3,840 x 2,160 with no AA.

ARKHAM ORIGINS	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 Ti	332.21	44
NVIDIA GTX 780	332.21	43
NVIDIA GTX TITAN	332.21	41
AMD RADEON R9 290X	13.12	38
AMD RADEON R9 290X CROSSFIRE	13.12	66
NVIDIA GTX TITAN SLI	332.21	57
EVGA GTX 780 ACX SLI	332.21	57

HITMAN: ABSOLUTION	DRIVER	FPS - HIGHER IS BETTER
NVIDIA GTX 780 Ti	332.21	44
NVIDIA GTX 780	332.21	39
NVIDIA GTX TITAN	332.21	40
AMD RADEON R9 290X	13.12	44
AMD RADEON R9 290X CROSSFIRE	13.12	75
NVIDIA GTX TITAN SLI	332.21	55
EVGA GTX 780 ACX SLI	332.21	55



**“Keyboard
of the
Year.”**



PC POWER PLAY, MARCH 2014, ISSUE#225

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VENGEANCE**

K70

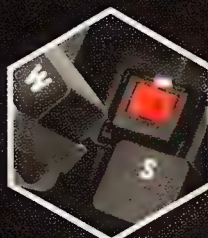
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When you're playing to win you need tools, not toys. Pro gamers around the world are making the K70 their weapon of choice because of its unprecedented combination of performance, comfort, durability, and style. If you've gotten yours, you know. And if you haven't, you've probably been beaten by someone who has.

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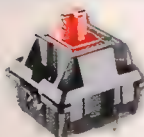


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OR BLUE KEYSWITCHES**



**KEY-BY-KEY
CUSTOMIZABLE
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Corsair Vengeance K70 is built with original Cherry MX keyswitches, the #1 choice of gamers. Made in Germany with unequaled precision using real gold cross-point contacts, Cherry MX keyswitches have proven performance and consistency with over 5 billion in use around the world.



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MX RED**
Ultra-fast,
ultra-smooth
linear response



**CHERRY
MX BROWN**
Silent, with
light tactile
feedback



**CHERRY
MX BLUE**
Tactile feedback
with an
audible click



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CHERRY

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.



HARDWARE

FIXING IT MADE THINGS WORSE

I have an Alienware M17X R2 gaming laptop. A few months ago it started to become very glitchy. Programs stopped working and I would get a blue screen almost daily. I then took it upon myself to reformat it. The restore partition had become corrupted, so I had to do a fresh install of Windows, after which everything worked amazingly. And then came the problem.

My brother — who knows more than I do — told me that I needed to flash the video BIOS. Or update. I'm not sure if it's one and the same. He then did this for me, but now my laptop will randomly dim and then go back to normal brightness. Sometimes, it just stays at its lowest brightness. Also, my games do not play any more and are very jerky regardless of which graphical settings I use. Knower of all things past, present and future, I ask you for your compassion.

Chris Sebastiao

Your brother doesn't appear to be familiar with the expression, "If it ain't

broke, don't fix it." On your actual problem, the positive news is that the M17X R2 doesn't have integrated graphics; this is a good thing because it proves that you haven't bricked your dual Mobility Radeon HD 4870 graphics cards entirely. The video BIOS currently on Dell's download page for the M17X is for the 5870. I'm fairly sure that will brick a 4870, so it's possible that you only flashed one of your two cards. You might be able to recover this by flashing back to the 4870 VBIOS, but probably only if you had the foresight to back up the old BIOS. I've looked around and I can't find the 4870 VBIOS available anywhere, so it's possible that you will need to replace the bricked video card altogether.

Luis Villazon

WINDOWS

ETERNAL UPDATES

I've got an Alienware Area 51 PC with Windows 7. Over the last couple of weeks it seems to be trying to install the same



The Windows 'looping update of doom' problem is usually caused by bugs in the updates themselves.

updates. Every time I try to shut down it says 'Installing updates 1 of 2' and then takes about five minutes to shut down. When I start up, it says 'Configuring updates', then 'Updates failed' and again takes about five minutes to get going. I've looked at Windows Update History and it seems to be something to do with Microsoft .NET v3 that keeps failing, but I can't seem to stop it from trying. Please help — I feel like I'm wasting my life away watching these update screens.
Malcolm Day

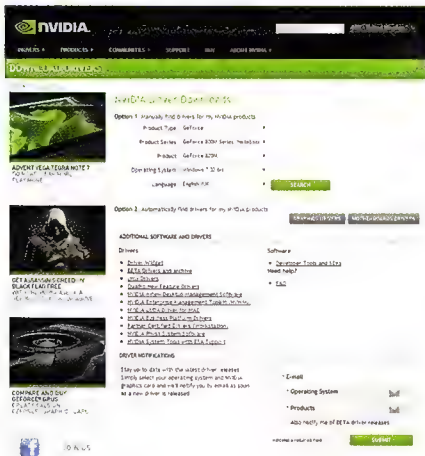
Ah yes, the looping update of doom. This problem is caused by bugs in the updates themselves and has been happening quite a lot recently. There was a big one back in September 2013 that caught out tens of thousands of users. And just before Christmas that year, my dad hit another one. I haven't seen any for Windows 8 yet, so perhaps they've changed the way Windows Update works.

The fix is to download the System Update Readiness Tool from tinyurl.com/6ghwfnf. And by 'readiness tool', Microsoft actually means 'hotfix'.
Luis Villazon

HARDWARE

SPONTANEOUS SHUTDOWNS

A month ago I bought a GeForce GTX 770, ASRock Extreme 6 and a Corsair GS800. I put these in a new case with my i5-3570k and 8GB RAM. I am running Windows 8 (64-bit). While I was gaming a few weeks ago, my PC suddenly shut off. I ignored it and carried on, but then it happened a few times more. A friend said it could be a



Drivers are the cause of many problems, but sudden power loss is not one of them.

problem with the drivers, so I re-downloaded and reinstalled the latest ones. The problem didn't happen for a week, but then it happened again while I was at a friend's house.
Luca Ruggier

It's definitely not the drivers. Drivers get blamed for a lot of things, but fortunately they can't cut the power to your PC instantly. This is a motherboard short circuit or a PSU fault. The ready reckoner at support.asus.com/powersupply.aspx suggests that your new system shouldn't need more than a 700W PSU, and your Corsair is a reputable model rated for 800W. Therefore, it looks like you are going to have to return either the motherboard or the PSU under warranty. If you got them both from the same supplier, return both and let them sort it out. Otherwise, I'd start with the PSU. It's easier to swap out and my bones tell me that it is more likely to be the culprit.
Luis Villazon

MAC ERASING A PREVIOUS OWNER

I own a second hand 1TB Mac mini Server, running Snow Leopard Server. I did a reinstall from the discs and set up a new account for admin purposes. However, the previous owner's admin account is still there. I've changed the password but I'd like to delete it forever. I've tried another reinstall, just in case, and I've since upgraded to Mavericks — neither has helped. It seems impossible to remove an account that had admin rights. This can't be right, surely?
John Marsden

Have you tried deleting it from the Users & Groups Preference pane? You need to be logged in as another admin user and click the padlock icon to unlock it. If that doesn't help, click 'Login Option > Join button > Open Directory Utility > Directory Editor tab'. Click the lock icon, then select the

user to delete from the list on the left. Click the minus button, then Delete. Now create a new user account with exactly the same name and long name. Log in to this, right-click the user name and choose 'Advanced Options'. Click Choose and navigate to the home folder for this user. Reboot and log into this new user, right-click the home folder in Finder and choose Get Info. Unlock the padlock in 'Sharing & Permissions'. Select this user, click the gear icon, then 'Make owner'. Then do the same and choose 'Apply to enclosed'. Now reboot and try deleting the user again. Phew, that was a long one!
Luis Villazon

LINUX A FRESH START

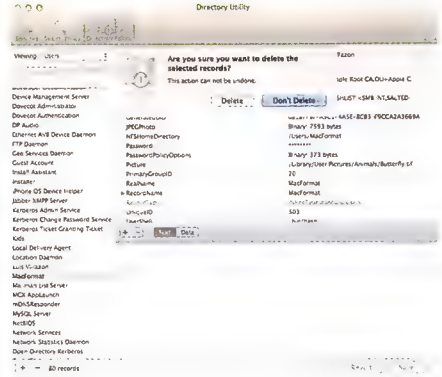
Due to Microsoft's recent withdrawal of its support for Windows XP, I have decided to give Linux a try on my functioning (if long-in-the-tooth) HP Pavilion zv6115 laptop. My only connection to the internet is through mobile broadband using a mobile broadband Wi-Fi hotspot.

I downloaded Ubuntu 12.04.3 LTS and I was really surprised at how easy it was to create a dual-boot machine. But why did the installer disconnect and not reconnect the WLAN card and how can I correct this? The Wi-Fi still functions when in XP mode. I have tried a live boot of Mint 16, which I like a lot but I cannot find a firewall in it, is there one? I've seen screenshots showing a firewall icon in Mint, but this is missing when I ran Mint 16 live, do you have to download it? Do you have to have antivirus software when using Linux and which one?

I thought Linux was for computer geeks before trying it myself, and now I find that it's not quite so.
William Hind

Well done for taking the plunge and trying something new. Linux, as you'll have no doubt discovered, is very different to Windows and so many things require a different approach. The reason your wireless is not working is that either the driver or firmware for the card is not installed. Without knowing the exact card you have, we cannot tell you which driver to use, but if you open a terminal and run `lspci` you will see a list of the devices in your computer. Find the line that relates to the wireless controller, which will be something like: `02:00.0 Network controller: Qualcomm Atheros AR9485 Wireless Network Adapter (rev 01)` and put the name and model of the wireless adaptor into your favourite search engine, along with the word Linux. This should show you which driver it uses and how to install it. The reason it works with Windows is that HP will have installed the Windows driver along with the OS.

The firewall icon you saw in that



There's a lot of hoops to jump through, but it is possible to remove old admin users.

screenshot was for Gufw, the graphical front end to the Ufw firewall program installed with Mint. Gufw is not installed by default, so go to the software centre, type `gufw` into the search box and install it from there. Linux doesn't use firewalls in the same way that Windows desktop machines need to. The actual firewall functions are provided by the Linux kernel, the other programs are simply ways of setting this up.

One of the main uses of firewalls on Windows is to block outgoing connections from rogue software. This is not an issue with open source software as it is not practicable to hide malware in software when the code is open for inspection. As long as you only install software through your distro's package manager or software centre, you shouldn't need an outgoing firewall. It's also normal for distros to not install software that accepts incoming connections by default, so a firewall is not really needed there either, unless you are running internet services, but it doesn't hurt to have one.

There are next to no malicious Linux viruses in the wild, so most consider antivirus software unnecessary. If you do want to run something, ClamAV, available from your distro's package manager, is the preferred choice. However, the main use of this is to scan for Windows viruses on files that may be shared with Windows users, although running it over your system regularly will give peace of mind.

APC staff



If you need antivirus for Linux, ClamAV is a good free solution that's available for many distros.

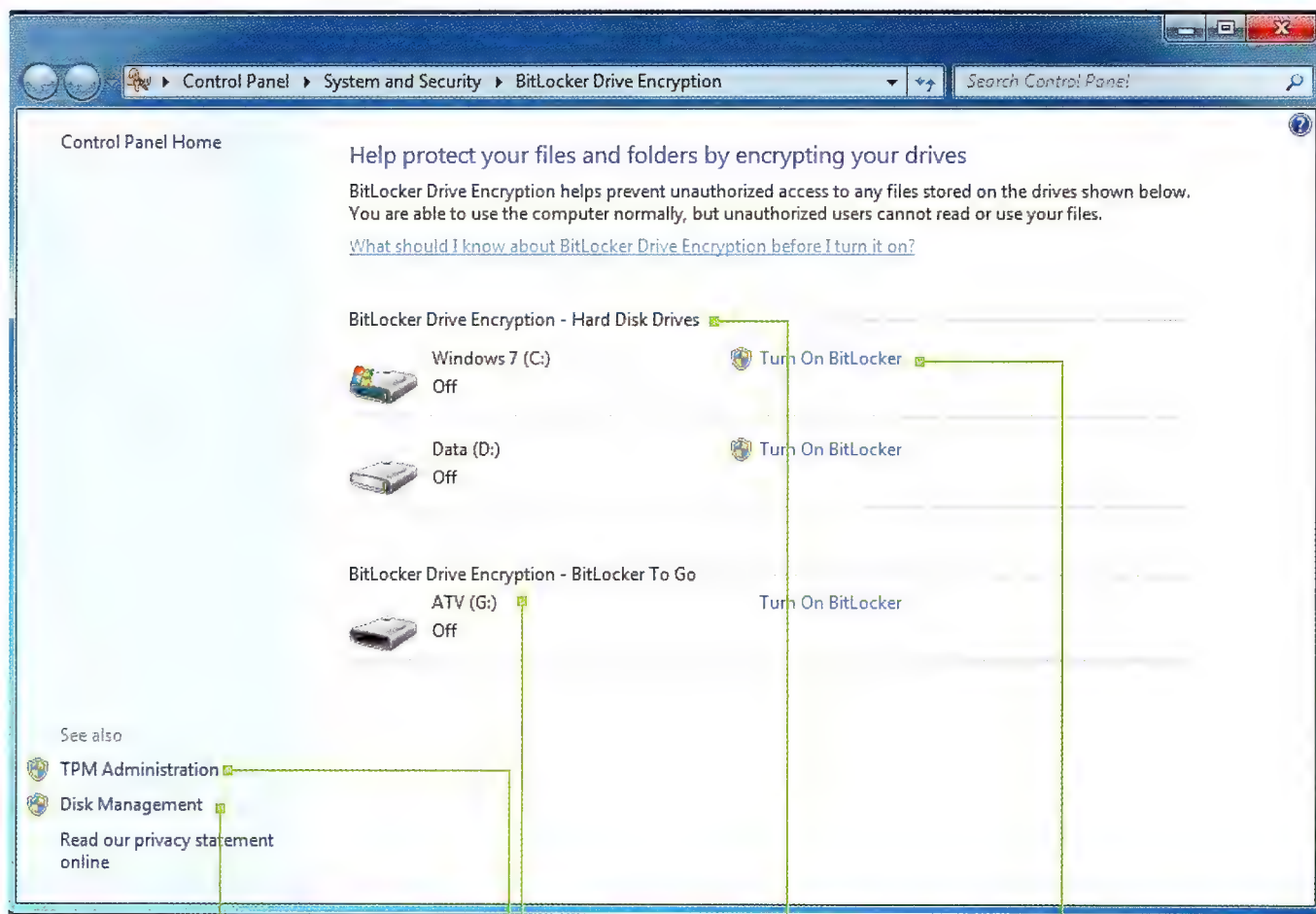
Encrypt files in Windows for free

Data encryption needn't be expensive. Christian Hall shows you how BitLocker can make your files more secure, for free.

Security matters, and many of us have vital info on our PCs that we don't want to fall into the wrong hands. Thankfully, if you own the Ultimate version of Windows Vista or Windows 7, or the Pro version of Windows 8, then you can protect the data on your PC with Microsoft's BitLocker tool.

BitLocker Drive Encryption protects your documents by adding a password that secures your data using AES-128 encryption – a high standard in digital cryptography that's almost impossible to crack. BitLocker also uses the Trusted Platform Module (TPM), a hardware component installed in many newer systems sold today.

This technology protects the keys used to encrypt the computer's operating system volume (usually the C drive), which enables BitLocker to secure your precious data from even the most hardened of hackers.



DISK MANAGEMENT

This launches a new window for the full Disk Management tool in Windows, so you can resize or reformat partitions if required.

TPM ADMINISTRATION

This link takes you to the Trusted Platform Module Administration window, where you can customise the TPM policies on your machine. Thankfully, there's a Help link from this area to assist with any queries.

PORTABLE DRIVES

Underneath your hard drives are USB flash drives, if any are connected to your PC. This is BitLocker To Go. A drive letter and BitLocker status are also displayed here.

HARD DRIVES

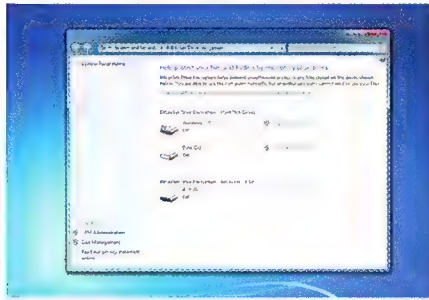
The standard BitLocker Drive Encryption tool operates on your internal or external hard disks. Each drive is listed here, along with its drive letter and whether BitLocker is currently activated or not.

BITLOCKER PROGRAM

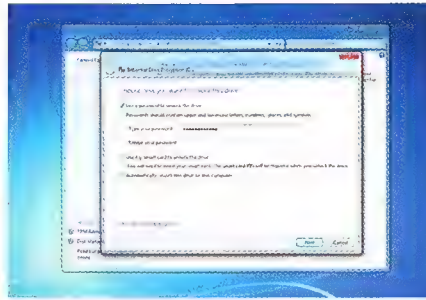
Alongside your hard drives or USB drives is a link to start the BitLocker Drive Encryption tool. Once BitLocker is activated, you can manage your encryption from here.

Master BitLocker Drive Encryption

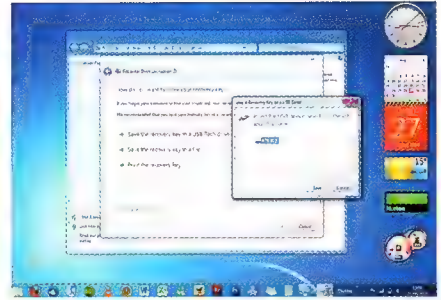
Protect your files the right way.



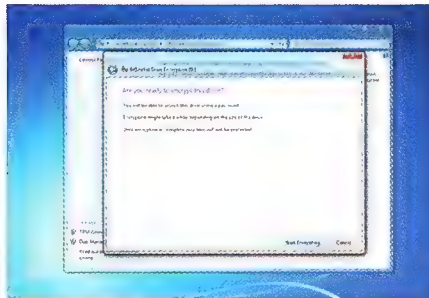
1 CHOOSE DRIVE TO ENCRYPT Head to 'Control Panel > Security > BitLocker Drive Encryption' and choose the drive you wish to encrypt (this will usually be C), then click 'Turn on BitLocker'. You'll be presented with a message asking you to initialise TPM Security Hardware; simply follow the prompts to do so. If this fails, there's a workaround — see step six.



2 CREATE A PASSWORD You'll need a password to access your drive once it's been encrypted. There are two options — typing a direct password or using a smart card. The latter means you need to insert a storage card (such as an SD card) and unlock it with a PIN. You can also opt to unlock the drive automatically if you're logged in.



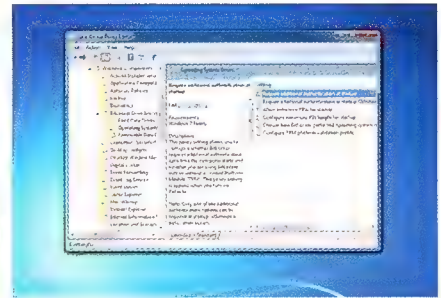
3 SAVE RECOVERY KEY On the next screen you need to decide where to store your recovery key, which you'll need in order to access your encrypted drive if you forget your password or lose your smart card. It's important that you keep this safe — you can print it out, store it as a text.



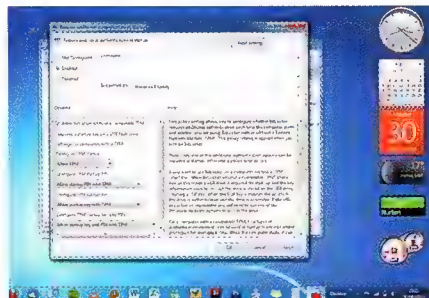
4 BEGIN ENCRYPTION When you're ready to begin encrypting your drive, hit the Start button to initialise the encryption process. This process might take quite a while, depending on the size of your hard drive, its speed and how much data is on there. Typically, BitLocker will take at least 20 minutes to fully encrypt your files, so leave it running while you make a cup of tea.



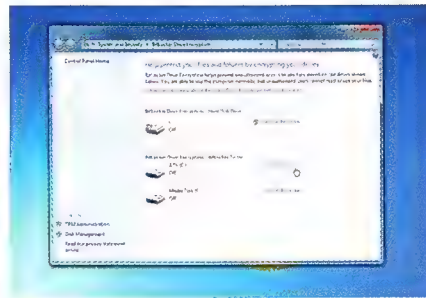
5 UNLOCK A DRIVE From now on, when you want to access the encrypted drive, you first need to type in the password to unlock it. You'll notice that the drive's icon has changed to show that it's encrypted with BitLocker. A gold padlock icon indicates that the drive is protected and can't be accessed, and a grey lock is displayed after you have unlocked it with your password.



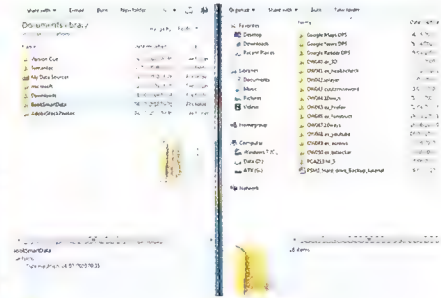
6 USE WITHOUT TPM If you see an error message that there's no TPM, click Start and type `gpedit.msc` into the Search box. Under Local Computer Policy go to 'Computer configuration > Administrative templates > Windows components > BitLocker Drive Encryption > Operating System Drives' and double-click 'Require additional authentication at startup'.



7 ALLOW BITLOCKER Enable the feature and check the box next to 'Allow BitLocker without a compatible TPM'; then click 'Apply > OK' to confirm your choice and close the Local Group Policy Editor. You can now go back to the hard drive you want to encrypt and turn on the BitLocker feature. You'll need to restart your computer to prepare the disk for encryption.



8 ENCRYPT A PORTABLE DRIVE If you use Win 7 Ultimate, in addition to the full desktop version of the program, you have BitLocker To Go for encrypting USBs. To give it a try, plug a USB drive into your PC and follow the same process you used to launch BitLocker, but choose your USB drive from the menu instead. You'll be prompted to choose a portable password or the smart card method.



9 CHECK YOUR SECURITY You've made the data on your PC or portable USB drive much more secure. When you add new files to a drive that is encrypted with BitLocker, it encrypts them for you automatically, so once you've followed this tutorial and secured your drive, all your work will be encrypted by default, and nobody will be able to access it without your password. ■

Ditch XP and switch to Linux

Linux can be a bit scary for newbies, so Neil Mohr and Matt Hanson are on hand to demonstrate how to swap dusty Windows XP for sparkly Mint 16.

Do you know one of the 29% of desktop PC users out there who still uses Windows XP? Yes? Then do them a favour – tell them to stop and hand them this article. As of 8 April 2014, Microsoft has ended all support for its ageing closed-source OS. This means every new exploit and security flaw will go unpatched and unfixed, and will remain as a gaping hole in people's digital lives. It really is a bad situation, because it's going to lead to identity theft, an increase in spam and more botnet activity. Of course, it also means that vulnerable people will potentially be exploited. One of the problems is that Windows XP works well for a large number of users, and because of this, they're unwilling to change their habits – irrespective of security concerns.

We're here to try and help shift people away from Windows XP. In our view, many people simply don't care what their underlying system is, just as long as it works and offers the same programs and online access – and what better system could we offer than Linux Mint 16?

GET STARTED NOW

We'll show you how you can take an existing Windows XP PC, rejig the partitions, install Linux Mint and retain access to any old Windows XP files, while gaining the benefits of a

modern Linux OS. You can get all of this by following the article and using a couple of easy downloads from www.linuxmint.com.

This article is based on a 64-bit version of Mint 16, plus a System RescueCD bootable Live CD (www.sysresccd.org). That means you need a 64-bit compatible processor. See the box below on alternative distros if you need a 32-bit build, as it's likely you'll want a low-requirement distro as well.

Are you unsure about whether you have 64-bit compatibility? Well, Intel 64-bit support was introduced with its Pentium 4 Prescott back in 2004 and has been mostly across the board for desktop processors since 2005 and its entire Core 2/iX range. In regards to AMD, it introduced the 64-bit compatible Athlon 64 back in late 2003 and this had filtered through its entire line by 2005. So unless a system is more than nine years old, it should be compatible with 64-bit. Don't worry if yours isn't – all distros offer 32-bit alternatives for non-64-bit systems.

Linux Mint can squeeze into 8GB of HDD space, but more is really recommended. Our guide is going to suggest reducing the Windows XP partition (or a suitable data/file partition) to squeeze in room for the Linux boot partition. For this, there needs to be at least 8GB of free space on that partition. In some circumstances, you'll need to delete

any unwanted files before this can happen. It's better if you have a lot more free space, but we'll work with what we can get.

You might wonder why we're working with an additional partitioning program when Ubuntu-based distros have one built in. The truth is that while the built-in partition tool works well, it's pretty awkward to use and we're really trying to make things as simple as possible. The GParted tool is far slicker, and if people finally adopt Linux then a partition tool is going to be needed for removing Windows and resizing the root partition. In most cases, that's best done from a boot CD.

If you run into issues, there is plenty of online support – often these will involve the terminal. What's that you say? The terminal is often portrayed as a black slab of death in circles outside the Linux world. It's nothing more than the Linux version of the command line but is far, far, far more powerful. The terminal allows entire servers to be administered – you can hack the world from here!

And that's it. You'll have Linux up and running. Turn the page to see how easy it is to access your old Windows documents and check out the alternative programs you can use. They're free, easy to install and waiting to be discovered.

Distro divas

As we've mentioned, we've based this guide on a 64-bit Linux Mint distro, but there's no reason you can't substitute these options with your own choices. In some circumstances, this could be for compatibility. A 32-bit lightweight option (such as www.puppylinux.com at 161MB or www.bodhilinux.com at 613MB) may well be the only real choices for the more ancient XP systems out there. When

XP was launched in late 2001, 32-bit was all the rage and remained so, especially on mobile systems, until the mid-2000s.

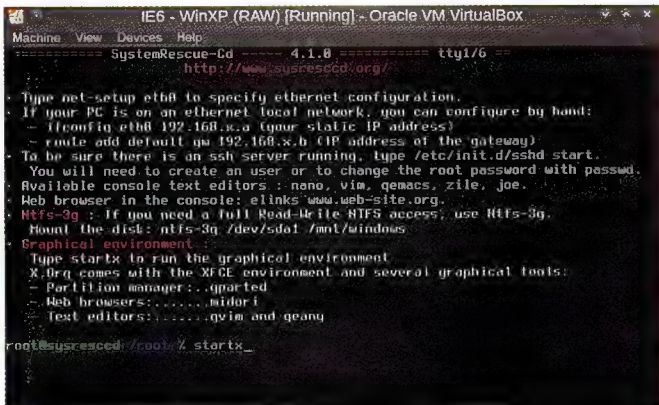
Past issues of APC have offered various releases of both Ubuntu and Linux Mint, or you can grab a download from www.linuxmint.com or www.ubuntu.com.

For repartitioning, we're going with the all-powerful SystemRescueCD distro, which is available from www.sysresccd.org. It might be overkill for a basic repartitioning

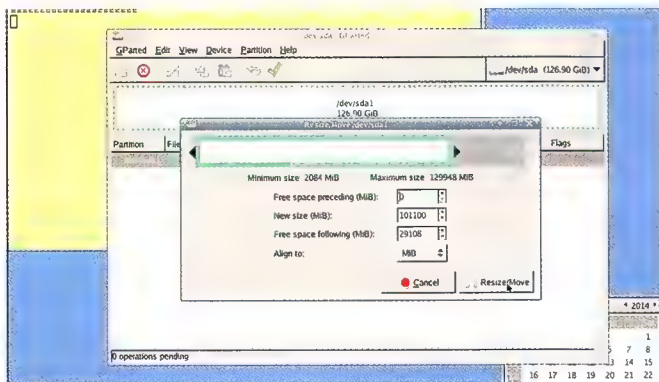
job, but it's always handy to have around. You might want to consider the more direct Gparted Live distro at 175MB from www.gparted.org, which boots directly into a graphical desktop with Gparted ready for action.

Bye-bye Windows XP

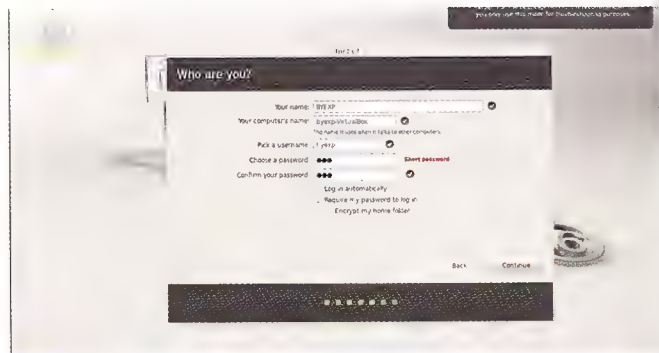
Remove the unsupported OS once and for all.



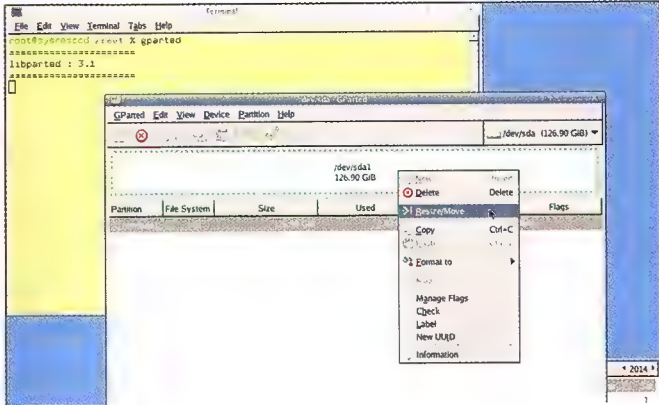
1 GPART IT Boot the system from the SystemRescueCD, or create and boot your own. Select the default boot — the alternatives will help solve potential problems you might experience. Select the default keyboard and type `startx` at the final command prompt. This will fire up the default Windows environment.



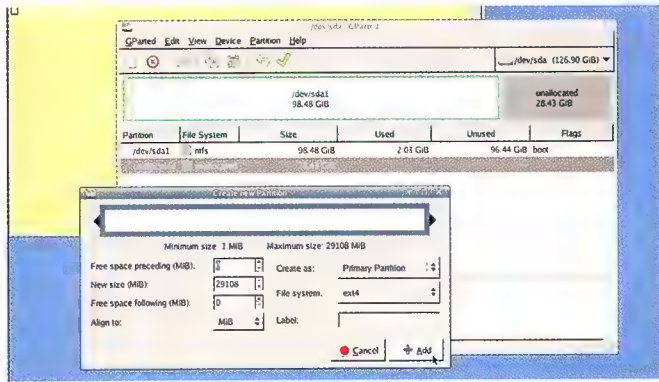
3 MOVE IT Grab the right-hand handle and resize that partition, you'll want the free space to read at least 8,096MB — ideally this should be a lot more. You'll see over the page how you can still access your Windows XP partition, so you don't have to worry about things there. Click 'Resize/Move' to make the selection, but nothing will happen yet.



5 INSTALL IT Reboot and switch to Linux Mint. Select 'Install Mint' and you'll see a familiar install system. It'll eventually ask to install Linux Mint alongside Windows XP. Accept and you're on your way. Just like with Windows, you will need a user name, network PC name and a decent user password to protect your admin aka root access.



2 RESIZE IT You need to start GParted. This is the icon on the bottom-left, or you can just type `gparted` into the open terminal. What you see next depends on the complexity of the host system's partition structure. It could be a single partition, or it could be several. You need to right-click on the one that has the most unused space.



4 CREATE IT Now you've found some space for your Linux partition, we're ready to go. You won't need to partition or format this space. The installer we're about to follow will identify this as where it should install itself. To apply these changes, click the 'Apply All Operations' button. Depending on the amount of stuff, this can be a quick or slow process.



6 BOOT IT It won't take long to install Mint and download the latest updates. Once in, you should find Linux Mint to be a pretty similar experience to the long outdated XP, except it will be far more secure and — importantly — it is still supported as an operating system. See over the page for all your replacement Linux programs.



Tah-dah! Linux Mint 16 at your service and isn't it rather nice.

Learning to love Linux

So you've made the switch from Windows XP to Linux. But how do you make sure you can open all your documents and carry on using your PC?

Just because you have switched from Windows XP to Linux, it doesn't mean that you won't be able to access your existing files, or will have to radically change the way you use your computer. The aim of this tutorial, along with Neil's walkthrough on the previous pages, is to make the switch from Windows to Linux as smooth and painless as possible. For many APC readers, the concept of a Microsoft operating system is but a hazy memory. If you are one of those people, then these guides are ideal for handing over to friends or family who have yet to make the leap to Linux.

One of the biggest worries for people moving from Windows to Linux is that they won't be able to open their old files, or use the programs that they're used to. Thankfully, this worry is easily allayed, as an increasing number of applications have Linux versions. The beauty of open source software

is that if an application isn't available on Linux, there's a very good chance of there being an alternative that will do just as good a job — if not better.

GETTING YOUR FILES

If you followed Neil's guide on the previous pages, you'll have installed Mint while keeping your Windows

distributions, have similar folders (usually without the 'My' prefix). While it's perfectly feasible to copy and paste your documents and files from your Windows XP partition to the equivalent folder in Linux, it's a better idea to leave the files where they are. When you then edit them in Linux, the changes will still appear if you then

"One of the biggest worries for people moving from Windows to Linux is that they won't be able to open their old files."

XP installation and personal files intact. This means that while you are in Mint, you will be able to browse the drive on which Windows XP is installed, and access all of your files. In Windows XP, these are usually kept in My Documents, My Pictures and so on. Mint, and many other Linux

open them up in Windows. To make life easier, it's worth creating shortcuts to your XP folders so they are easily accessible in Linux. When you open up the file browser, you should be able to see the drive or partition on which Windows XP is installed.

Depending on what distribution

you're using, the process might be slightly different, but in Linux Mint you can quickly access the file manager by double-clicking the computer icon on the desktop. In the window that opens, you will see all the drives connected to your computer. By double-clicking the drive on which Windows XP is installed, you can browse to your existing files by going to 'Documents and Settings > Username > My Documents', where Username is the name of the account that you use to log in to Windows XP. If you right-click My Documents, or on any folder you want to have quick access to, and select 'Make Link', you can then drag the newly made link to your desktop for quick access. You can also add the folder to the left-hand Places bar in the File Explorer menu. To do this, open up the folder, click on Bookmarks, then 'Add Bookmark'. The folder will now appear on the left underneath Bookmarks.

As Linux adoption grows, so does the number of Linux ports of popular Windows and Mac programs. Dropbox, the popular file synchronisation program, has a Linux client, as does Skype. Steam also has a Linux client, and an increasing number of recent games are Linux compatible.

BROWSE THE WEB

If you use Google Chrome or Mozilla Firefox to browse the internet, then you'll be able to continue using them in Linux. And the best bit is they will both let you synchronise your bookmarks, passwords and browsing history. If you've been using Internet Explorer then you're going to have to make do with a new browser — although that might not be such a bad thing. However, you can make life easier by exporting your bookmarks from Internet Explorer and importing them into Firefox in Linux. To do this, open up Internet Explorer in Windows and click on the star icon. Click the down arrow to open up the drop-down list, and select 'Import and export', then 'Export to a file'. Select what you want to export and click 'Next' until you get to 'Export' to create the bookmark.htm file.

In Linux, open up the Firefox browser and click 'Bookmarks' then 'Show all Bookmarks'. A window will open, and you need to click 'Import and Backup' then 'Import Bookmarks from HTML' and select 'bookmark.htm'.

If you were already using Thunderbird to get your emails in Windows XP, then getting Thunderbird set up in Linux won't be difficult at all. In Windows XP, navigate to the \Documents and

TOP LINUX ALTERNATIVES

WINDOWS APP	LINUX REPLACEMENT	
MICROSOFT OFFICE	LibreOffice (www.libreoffice.org). It's incredibly easy to replace Microsoft Office in Linux, with LibreOffice being arguably the best choice. It has plenty of tools for word processing, spreadsheet, presentation and more.	
MS PAINT	Gimp (www.gimp.org). Gimp is actually much more advanced than MS Paint's simple image editor, and can even give Photoshop a run for its money. It comes pre-installed on many distros.	
WINDOWS PHOTO GALLERY	Shotwell (www.yorba.org/projects/shotwell). Shotwell is a great replacement for Windows' photo organiser. You can import photos from digital cameras and smartphones, add tags and ratings and do some light editing to tidy up the shots.	
WINDOWS MOVIE MAKER	Open Movie Editor (www.openmovieeditor.org). For quickly importing and editing home movies, Open Movie Editor is a great alternative to Windows Movie Maker. It's easy to use, but has enough power to make some great-looking clips.	
WINDOWS MEDIA PLAYER	VLC (www.videolan.org). VLC is a very popular alternative to Windows Media Player, supports lots of different media formats, and can even play Blu-ray discs with a few tweaks.	
ITUNES	Amarok (amarok.kde.org). If you've got an iPad, iPhone or iPod then you might have thought you'd be stuck with iTunes. Thankfully, Amarok does an excellent job of replacing it, has loads of features, and lets you manage songs and files from your iDevice.	
NERO BURNING ROM	Brasero (https://wiki.gnome.org/Apps/Brasero#download). Burning files to a rewritable DVD or CD is made incredibly easy with this user-friendly disc burning software.	
WINZIP	File Roller (fileroller.sourceforge.net). It's likely you already have File Roller installed. It can open up or create a wide range of compressed files that are ideal for sending across the internet.	
NORTON ANTI VIRUS	Avast! Linux Home Edition (www.avast.com). Linux is far less prone to viruses and malware than Windows, that's not to say there aren't any out there or will be in the future, so get some protection.	
ADOBE ACROBAT READER	Foxit Reader (www.foxitsoftware.com). The Linux distro you've installed will probably already be able to view PDF documents, Foxit Reader is an excellent alternative that's fast, light and full of features.	

Settings\%username%\Application Data\Thunderbird\Profiles\ folder. In this folder there will be another folder that has a string of random letters and numbers, followed by .default as the name.

Copy this folder to a USB stick or another hard drive, then load up Linux. Open up the file manager and go to your Home folder (this is sometimes shown as the default view). Press Ctrl-H on your keyboard to display hidden files and folders, then find the .thunderbird folder. Open it, and paste the .default folder you saved earlier there. Then, open up the

profiles.ini file in the .thunderbird folder, and where it says Path= type in the name of the newly-pasted .default folder. When you next load up Thunderbird, your emails and folders etc should be waiting for you. If you're using Outlook in Windows XP then the easiest way is to install Thunderbird on XP, open it up and then go to Tools then Import to import your Outlook files. Then, copy the .default folder as we described earlier. ■

Get started with automation

One of the most useful parts of OS X is also one of the most overlooked. Matthew JC. Powell shows you how to work smarter with Automator.

Automation has been a feature of the Mac since the mid-1990s and System 7, thanks to a technology called AppleScript. AppleScript is incredibly powerful and incredibly flexible, but also incredibly complex. With it you can write scripts to make just about any application on your Mac do just about anything you want.

If your automation needs are a tad less demanding – and most users' needs are – Apple introduced a tool with Mac OS X 10.4 called Automator. In essence, it's a graphical tool for creating AppleScripts by drag-and-drop. There's no complicated syntax to learn, no commands to memorise. It's not as powerful as pure AppleScript, but because it is AppleScript, you can add whatever functionality you require if Automator falls short.

But let's not get ahead of ourselves. First, open up Automator and see what it can do. (Note: the screenshots are from the OS X 10.9 version. There are some differences if you're using an older version of OS X. Most instructions should still be fairly clear though.)

Choose a type for your document:

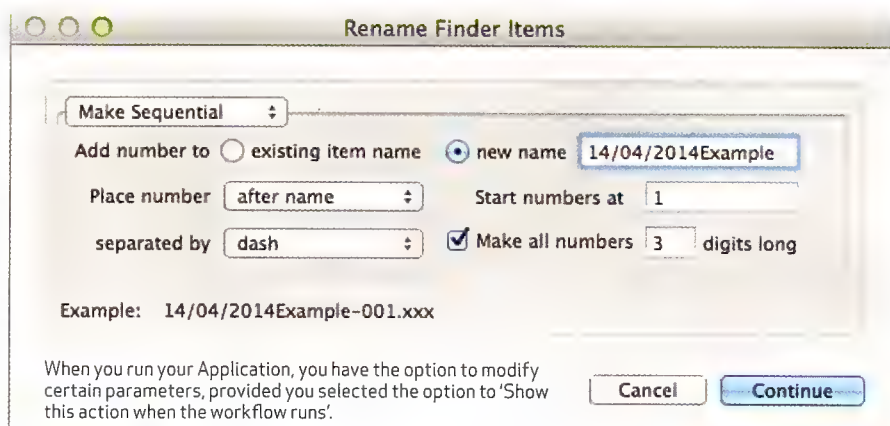


Application

Applications are self-running workflows. Any files or folders dropped onto an Application will be used as input to the workflow.

Before you start building your workflow, you should decide what kind of workflow the end result will be. Some of these can be changed later, but some can't. Choose wisely.

Close Choose



TEMPLATES

When you fire up Automator, you're presented with a palette of templates, representing the different types of script Automator can produce. These are:

- Workflow – The simplest type of script, which can be run within Automator itself.
- Application – Much like a Workflow, but doesn't require Automator to be running.

- Service – Services can operate system-wide within most OS X applications.
- Print Plugin – Add-ons for the Print dialogue.
- Folder Action – A script that's triggered when items are added.
- Calendar Alarm – Not really an alarm as such, this is just a script that's activated when certain criteria are met in iCal.
- Image Capture Plugin – Extend the functionality of that other great forgotten OS X tool, Image Capture.

For this first run, we're going to make an Application, so click on that and then click Choose or hit Return.

ACTIONS & VARIABLES

Once you've selected a Template, you're shown the main Automator window. At the far left is a column with two headings: Actions and Variables. The contents of the column change depending on which heading you select.

Click on Actions, and you'll see the Library, which should be expanded – if not, click on the disclosure triangle to expand it. Inside the Library you'll see all of the various categories of Actions that can be automated (in older versions of Automator, you would see Applications listed here rather than categories – since many Actions can work across multiple applications, this has changed in recent versions).

Click on Library, and in the next column over you'll see the full list of pre-built Actions available. Many third-party developers (including Microsoft) include Automator Actions with their applications, so this list will vary depending on what applications you have installed. It can be a very long list, so click on each of the categories

under Library (such as Files & Folders) to see the list of Actions that can be applied to different file types. It's well worth taking some time to explore the list of Actions, as you might get some ideas of tasks you need to automate.

If you click on Variables at the top of the column, you'll again see a Library which you can expand. Many of these are a bit esoteric and intended primarily for developers to use, but you may as well poke around if you want.

To the right of the list of Actions or Variables is the Workspace. This is where you drag and drop the Actions you want to automate, in the order in which you want them to happen.

A SIMPLE PROJECT

Just to illustrate how easy it is to do something quite powerful with Automator, we'll now build an application that will rename a group of files. It's simple enough to rename files on the Mac — one at a time. Renaming a folder full of them gets pretty tedious, especially if you're not comfortable with the Terminal.

To start with, find the Action called 'Ask For Finder Items'. If you click on the Files & Folders category, it's the top one. Or, you can type its name into the search field (at the top of the column). Click on it, and drag it into the Workspace.

Once in the Workspace, you see you can customise it slightly. By default, it will display a message that reads 'Choose a Finder item:' but you can change that to 'Pick something, dawg!' or whatever takes your fancy. You can also tell it to start at the Desktop or in a specific folder. For this project, you should also tick the box to 'Allow Multiple Selection'.

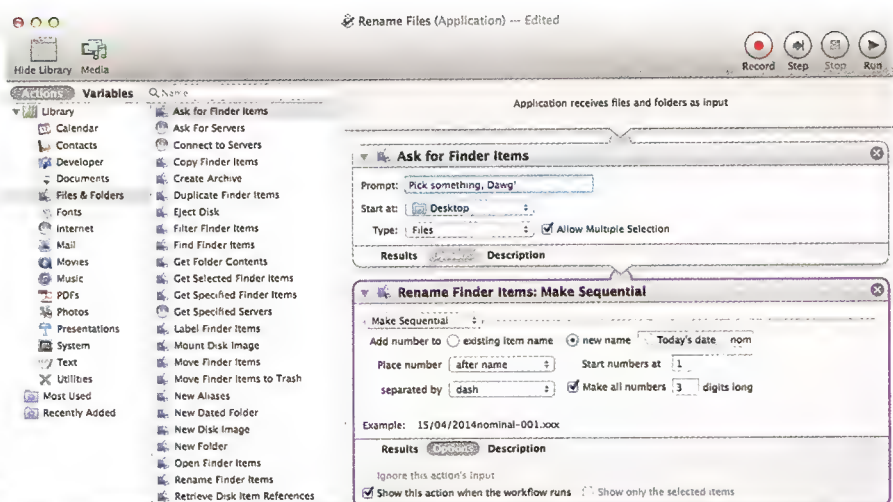
Next, find the Action called 'Rename Finder Items' and drag it over. Again, you have some options. For this example, click on the drop-down menu and select 'Make Sequential'. Click on the button next to 'new name' and leave the field blank (you could also drag a Variable in, if you want to).

Then decide how you want the numbers to appear in the new file names and in what format — a sample displays at the bottom. Then — and this is important — click on Options and select 'Show this action when the workflow runs'. This will allow you to choose a name to apply to a group of files when you rename them.

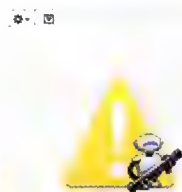
Finally, go to the File menu and Save your Application (in the Applications folder, if you want).

Now test your application. Run it, select some files (a folder full of photos with unhelpful camera-default names, for example) and give them names that will make sense to you.

Impressive, right? Tune in next time for more Automator tricks. ■



Ask for Finder Items
This action lets the user choose Finder items in a dialog when the workflow is run.
Input: Files/Folders
Result: Files/Folders
Version: 1.2.1
Copyright © 2003–2012 Apple Inc. All rights reserved.



When you add an Action to a workflow that can't be undone, Automator will give you the option of adding an intermediate step of copying your original files.

This action will change the names of the Finder items passed into it. Would you like to add a Copy Finder Items action so that the copies are changed and your originals are preserved?

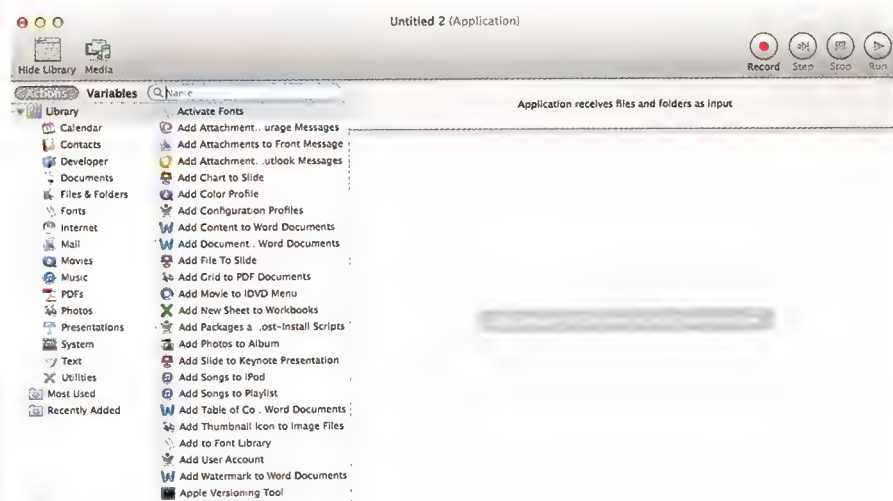
Hold the shift key when adding an action to avoid this warning sheet.

☐ Do not show this message again

Cancel

Don't Add

Add



Activate Fonts
This action activates the fonts passed from the previous action.
Input: Font Book typeface
Result: Font Book typeface
Version: 5.0
Copyright © 2004–2013 by Apple Inc. All rights reserved.

Automator's interface has columns for your Actions and Variables, the Workspace in which you drag and drop items, and a handy info field.

Free up space on your iOS device

Make room on your iOS device for new apps and media.

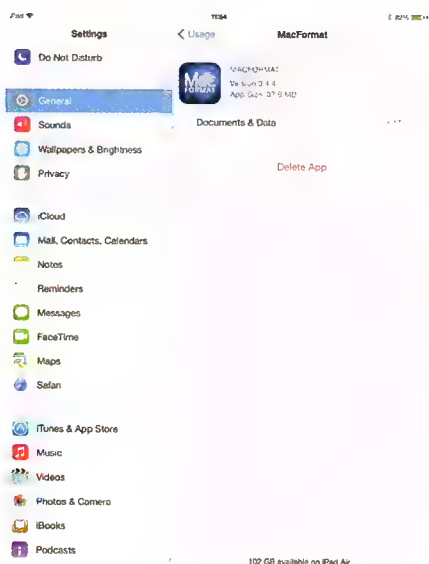
No matter what capacity iOS device you have, there will come a time when you'll find there's not enough space for a movie or big new game that you want to add. The good news is that you can clear apps, photos, videos and other items off your device at any time. The bad news is that it isn't always obvious how to delete various kinds of items, and different methods are needed for different items.

In iOS 7, however, it has become easier to find the space hogs. To begin, tap 'Settings > General > Usage' and right at the top, under the Storage heading, you'll see the Available figure. Need more? Let's look at the options.

DELETING AN APP

Your installed apps are listed on the Usage screen in order of size. (Scroll down and tap 'Show all Apps' to see smaller apps.) Tap one to see how much space the app itself takes up and how much is being used to store its data and documents. Except in the case of built-in apps, which can't be deleted, you can tap 'Delete App' to reclaim all this space.

You can also delete apps on your Home screen: tap and hold on an icon until they all start to jiggle, then tap



Tap an app's name to see how much space it's taking up, and how much its documents and data fill up.

"Bear in mind that deleting an app deletes its saved data and documents."

the X on an icon to delete that app. The effect is exactly the same either way.

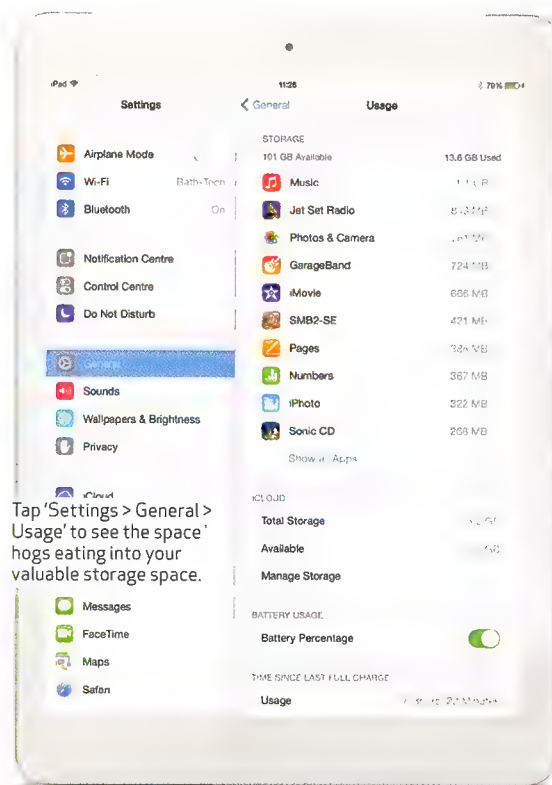
Whichever method you use, bear in mind that deleting an app deletes its saved data and documents. You can re-download any app purchased from the App Store, free of charge, but this won't restore its data – you'll need to use an iCloud or iTunes backup for that.

DELETE VIDEOS

Video files can be huge, so it makes sense to delete any you've watched or don't want. In the Videos app, tap Films, TV Programmes or Music Videos at the top of the screen, then tap Edit at top right, and tap the X on the unwanted file. To delete individual episodes of a TV show, tap the show title to see the list, then swipe to the left across an episode and tap the Delete button that appears. Note that if you delete a rented movie, it's gone for good. If you delete any other video file, it's removed from your iOS device but remains in the iTunes library on your computer, and will be added back to your iOS device next time you sync unless you set iTunes not to sync that particular video file.

DELETE PHOTOS

By default, every photo you take on your iOS device is saved in your Camera Roll and also copied into your Photo Stream. If you create shared Photo Streams, the same photo may be copied yet again. Your Photo Stream tops out at 1,000 photos, but this means you may have copies of the same photo cluttering up your iOS device. To delete a photo in your Camera Roll (whether accessed from the Camera app or the Photos app), tap the unwanted photo, then tap the trashcan (bottom right).

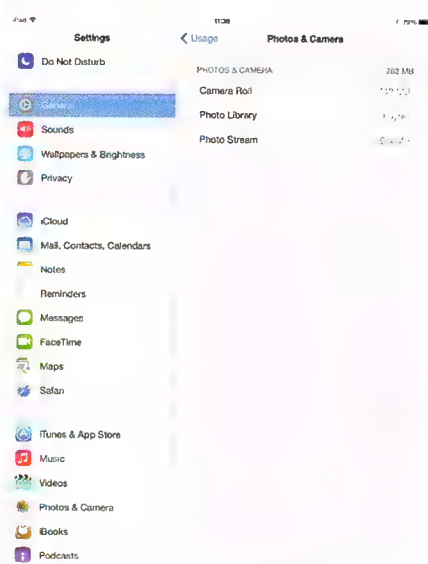


Tap 'Settings > General > Usage' to see the space 'hogs eating into your valuable storage space.

To delete multiple photos, tap Select (top right) first, tap the images you want to select, then tap the trashcan (top left).

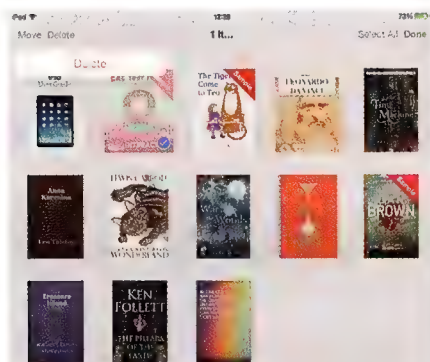
Use the same methods to delete a photo or multiple photos in a Photo Stream – to access your shared Photo Streams, tap the Shared tab at the foot of the screen; to access your default Photo Stream or other albums you've created yourself, tap Albums.

Bear in mind that deleting a photo from your Photo Stream will remove it from that Photo Stream on all your devices. However, it will not affect the original of that photo, which will remain in the Camera Roll of the device on which you took it (until you delete it manually). If you delete a photo from your Camera Roll, it may still appear in your Photo Stream but



Low on space? Check for duplicate images within your Camera Roll, Photo Library and Photo Stream.

will be removed from that Photo Stream – on all your devices – after 30 days (or earlier if you reach the 1,000 shot limit).



To delete a book in iBooks, tap Edit, then the item, followed by Delete and Done.

DELETE A SONG

In the Music app, go to Songs, swipe to the left on the song, then tap Delete. In iOS 7 it seems it's no longer possible to delete an entire album. Note that deleting a song won't delete the track from iCloud or from the iTunes library on your computer: if you don't want it restored next time you sync, you need to delete it there or set it not to be synced. Be aware that deleting a track from a playlist won't remove it from your iOS device – a playlist is just a list. Also, if iTunes Match is turned on, you can't delete music. If space is needed, iTunes Match will remove music for you, starting with the oldest, least played songs.

MAGAZINES AND BOOKS

Interactive magazines on the shelves in your Newsstand can take up a huge amount of space (particularly HD editions). To delete one you no longer

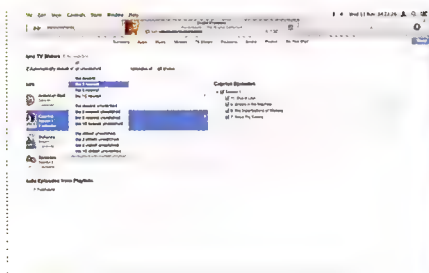
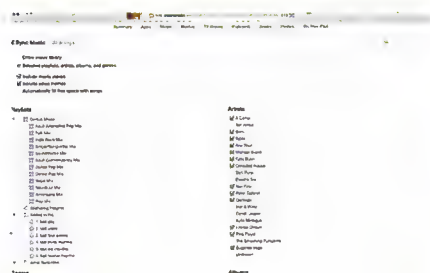
want, tap and hold any icon until they all start to jiggle, then tap the X on any you don't want. Press Home when done. Confusingly, you need a different procedure for deleting ebooks and PDFs. In the iBooks app, tap Edit, then tap each item you want to remove. Now tap Delete, then Done.

RESTORE ITEMS

If you want to restore a deleted app, you can download it again, for free, by going to the App Store and tapping Purchased in the bottom bar. For music, films and TV series, go to the iTunes Store and tap Purchased. For books, open iBooks, tap Store (top left), then tap Purchased (bottom right). You can also use iTunes on your computer to re-download apps, music and videos.

Manage space on your device using iTunes

Keep your files nice and tidy.



1 CONTROL THE MUSIC

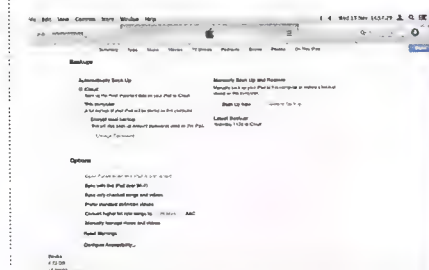
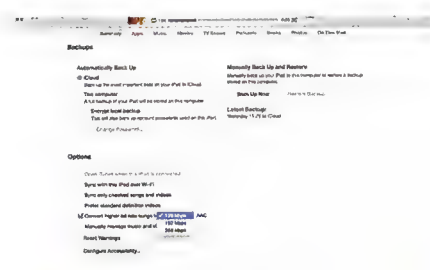
If you manage your iOS device using iTunes on your computer and your music library is set to sync to your device in its entirety, do you really want all that content on there? If not, go to the Music tab in iTunes and under Sync Music untick 'Entire music library'. Instead, tick 'Selected playlists, artists, albums, and genres'.

2 MANAGE OTHER MEDIA

If space is a problem, you probably don't want to enable 'Automatically fill free space with songs'. Now turn to the other media tabs, and tweak the settings so you're adding only what you want on your device. Under Movies and TV Shows, you can specify that once you've watched something, it's deleted.

3 CLEAR UNWANTED APPS

Now click the Apps tab and, in the pop-up menu at the top left of the list, select 'Sort by Size' to see the largest apps first. Apps with an adjacent Remove button are already on your device. Press the Remove button next to any large apps you can do without. The button's label changes to 'Will Remove'.



4 MAKE SONGS SMALLER

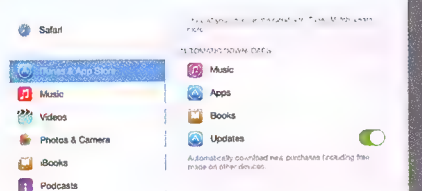
To fit more content on your device, you can choose to sync audio tracks at lower quality. On your device's Summary screen in iTunes, under Options, tick 'Convert higher bit rate songs to...' and select an option in the menu. A lower bit rate means less space taken up; the sound quality should still be acceptable.

5 ASSESS THE RESULTS

As you make changes to what's synced to your iOS device, you'll see the coloured capacity bar at the foot of the iTunes window update in real time to show you how much space you've still got free, or whether you've overshot. When you're happy, click Apply to commit all the changes you've made to your device.

AUTO DOWNLOAD

If space is short on your iOS device, go to 'Settings > iTunes & App Store' and disable automatic download of all your app, music and book purchases. Instead, you can tap Purchased in the store apps to download only what you want on your iOS device.



Stream home movies & music to Android, anywhere

Subsonic makes streaming your music and movies a breeze. Simon Chester explains how.

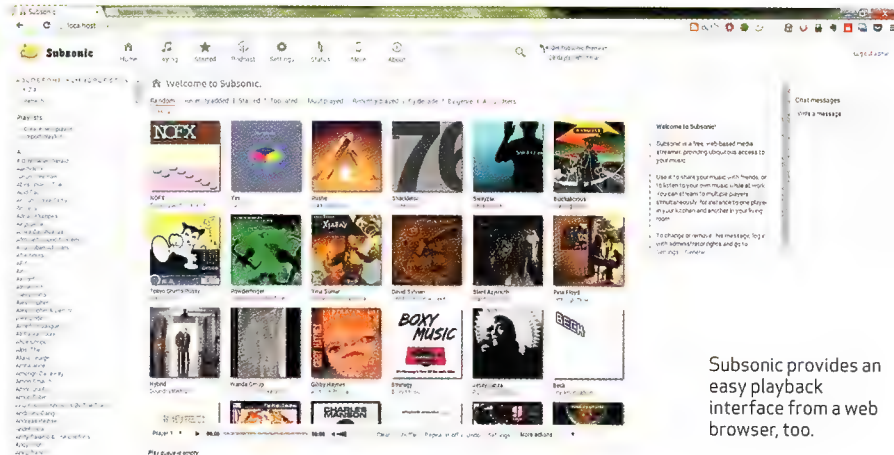
Music streaming services are undoubtedly the way of the future, as they give you access to almost every single song imaginable on the device that you always have in your pocket.

However, this unlimited selection can sometimes pose a problem, as it can be overwhelming to decide on an album to listen to (I generally like to browse a list of albums that I own or am familiar with), and – more importantly – there are some artists/albums that you love that just aren't available on the service.

Thankfully, there is a way around this dilemma – it's to make your own personal collection available to stream over the net.

There are many ways to accomplish this task, from port forwarding a UPnP server that you already run, then accessing that streaming using BubbleUPnP (or something similar), to uploading your collection to a cloud service like Google Play Music. My preferred method, however, is to use the excellent music server Subsonic, as it also allows you to listen (and watch videos) from a web browser, as well as a mobile app. You can even set up access for your friends, and optionally allow them to download anything they want from you, or send an album link to a stranger while on-the-go.

Subsonic is sort-of free software – it's released under GPL, but there are



Subsonic provides an easy playback interface from a web browser, too.

some premium features that require a subscription (admittedly, it's only \$1 per month) to work. Unfortunately for the misers in the audience, one of these is streaming to mobile apps.

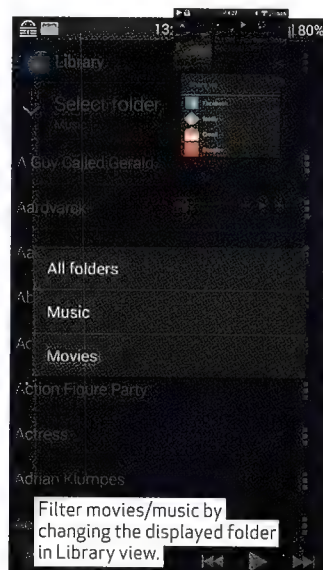
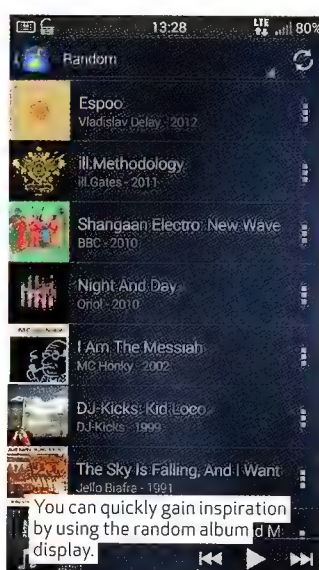
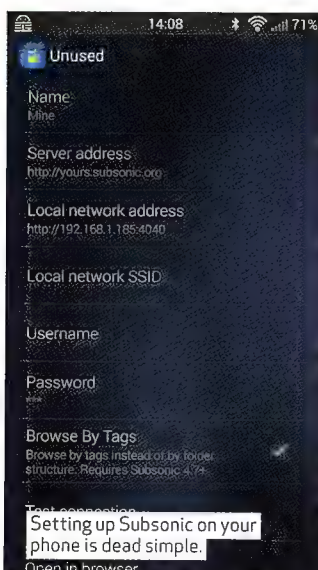
What is really great about the software, though – and makes it well worth the \$12 per year (which is literally 1/12 the cost of Spotify) – is that it's actually really easy to set up – even the streaming features are Apple-level simple.

You can download Subsonic from www.subsonic.org. As Subsonic runs on several different platforms, you should follow the install instructions to the right of your download link, but for Windows, it's just a matter of running

the install file.

Once you've installed the server, you need to configure it by visiting [http://\[ServerIP\]:4040](http://[ServerIP]:4040) (note that <http://localhost:4040> will work if you're using the same machine that you installed it on), and following the Getting Started guide. Here, you'll change the admin password, set up the media folders, and configure the network settings for remote access (you might have to forward port 4040 from your router to your PC).

Now that you have a Subsonic server up and running, it's time to connect your Android device and get streaming.



MOBILE STREAMING

There are two Subsonic apps available on the Play store: a free, official one called Subsonic, which is created by the same developer; and a \$3.99 third-party one called DSub.

I recommend forking out the \$3.99 for DSub, though, as it comes with a few valuable features – most notable of which is gapless playback (can you believe it?). It also comes with a heap more customisation options – including themes, and the ability to remove/override different UI elements – as well as lockscreen controls, better playlist management, and more. In short, it's worth the \$3.99.

Setting up the Android app is as simple as going to the settings menu and entering the **http://XXXX.subsonic.org** address that you registered during the software setup on your PC, followed by your username and password.

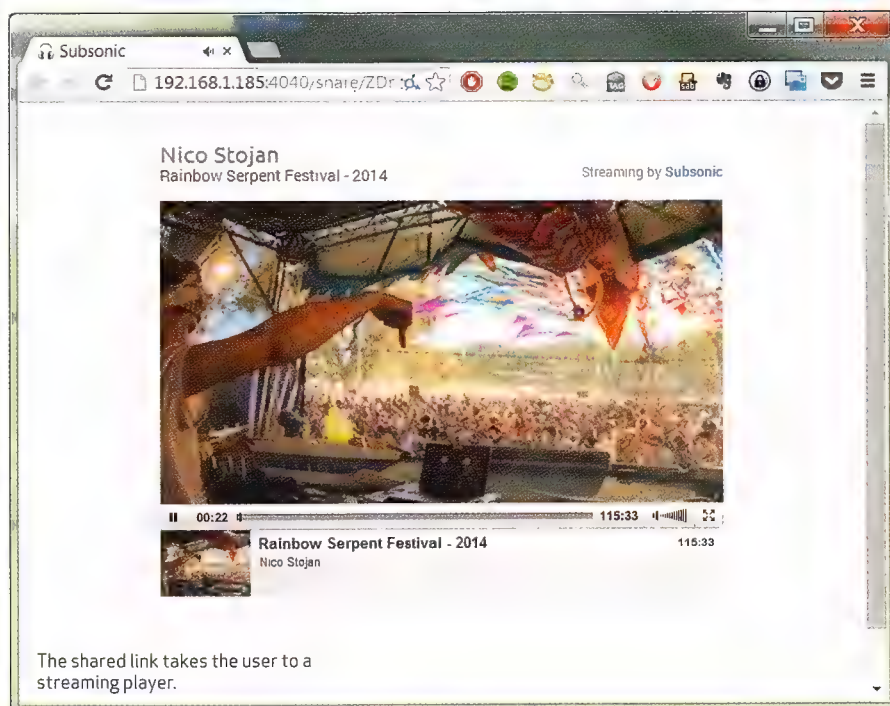
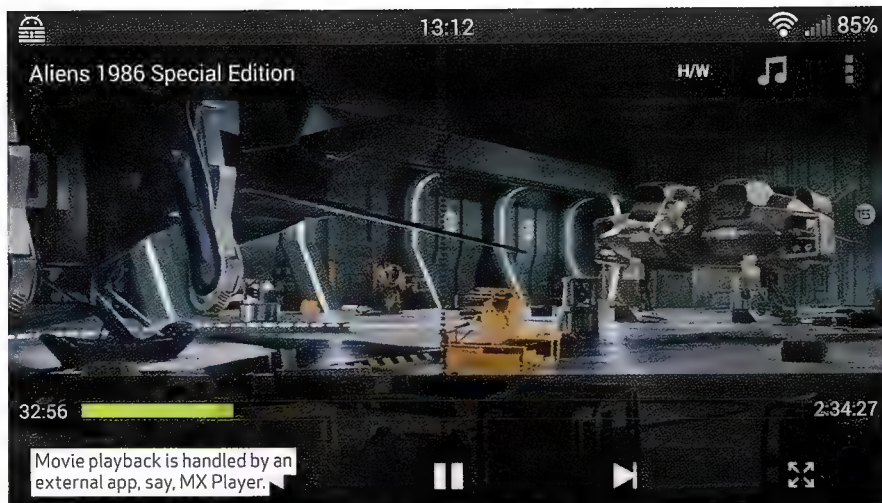
You should also set your maximum bitrate for streaming over mobile (under 'Settings > Cache/Network'), lest you want to eat into your monthly data allowance. This means that you can set a maximum quality/size rate for your music, which will really come in handy if you have any lossless music. I'd recommend setting the limit to 160Kbps, but if you're a bit more discerning, have a generous data limit, or won't be using it more than a few times a week, you should set it to 192Kbps or higher. The great thing about Subsonic, is that the transcoding is all set up out-of-the box – there's no phaffing required.

You can even have DSub periodically sync with your server, so that new items, starred items, podcasts etc. are always up-to-date on your device. You can control these settings (or turn off sync) under 'Settings > Sync'.

Unsurprisingly, you'll find the option to change the theme under 'Settings > Appearance', as well as a few other useful settings, including removing the chat, bookmarks, or podcasts menus from the pull out drawer on the side, and changing the way that the 'Play Now' feature handles subsequent tracks in an album.

Another neat feature of the Subsonic Android apps is that they can be used as a remote control for the Subsonic server – which is, of course, hooked up to your boomin' speakers. You can start this in DSub by pressing the cast icon up the top right of the Now Playing screen, and choosing 'Subsonic Jukebox' (I had two listed there, but only one of them worked).

Note that, if you created a separate user account for the Android user, you will have to grant it 'jukebox' privileges under the 'Settings > Users' page of the Subsonic server.



MOVIES

One other wonderful benefit of Subsonic is the ability to remotely stream videos, too. All you need to do is set your Movie/TV Show directory under 'Settings > Media Folders' on the Subsonic server, then, in DSub or the Subsonic app, go to Library, and under the 'Select Folder' drop-down menu up top, choose your Movies folder. You can then stream any movie you wish

(transcoding it on the fly, according to your chosen bitrate settings). So simple, it's like Steve Jobs himself designed it.

Of course, streaming movies over your 3G/4G connection is a sure-fire way to prematurely hit your data allowance, so stick to Wi-Fi, or use it with caution. ■

Google Play Music

Got the time to upload everything?

Now, there is actually a dead simple way to stream up to 20,000 of your favourite songs (for free), and that's by using Google Play Music. The downside here is that you actually need to upload all 20,000 of those songs, and that can be a major drag. Still the process is rather simple, and it can be a good way to make your collection accessible from almost any device or web browser, should you decide that Subsonic isn't for you. You can learn more about the service at tinyurl.com/7a9m5vm.

Create stunning gaming videos

Share your gaming prowess with a classy highlights reel. Chris Lloyd explains how.

Unless your sole creative aim in life is to get your videos on *Funniest Home Videos*, you need a decent non-linear video editor, like VSDC (www.videosoftdev.com).

The full feature set is extensive, and covers all the bases, including colour correction, green screen, multiple picture-in-picture, filters and much more. It's a little light on special effects, but there are no hidden fees, ads, or sneaky omissions.

The key here is to think in terms of objects. You build a video from a set of re-useable elements, clips, stills and sounds. These are built into sprites and scenes, which can be moved and manipulated as one. It's a full non-linear system, so you can use anything in any order, as many times as you like, at any size and shape. Nothing is altered in your source material, so you're free to experiment endlessly too.

TOP TIP

EASY ON THE EFFECTS

Use wipes, transitions and effects very sparingly; in fact, it's probably best to avoid transitions altogether, as their use has become the sign of an amateur.

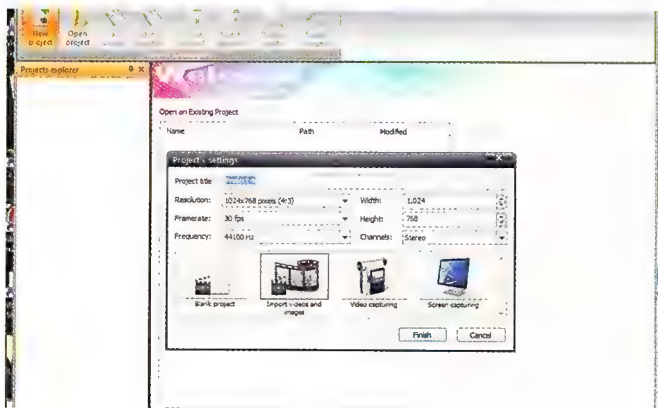
TOP TIP

THINK FIRST

Before you start, think about what you want to achieve. It's easy to waste a lot of time in the editor if you don't know what you want to get out of it in the first place.

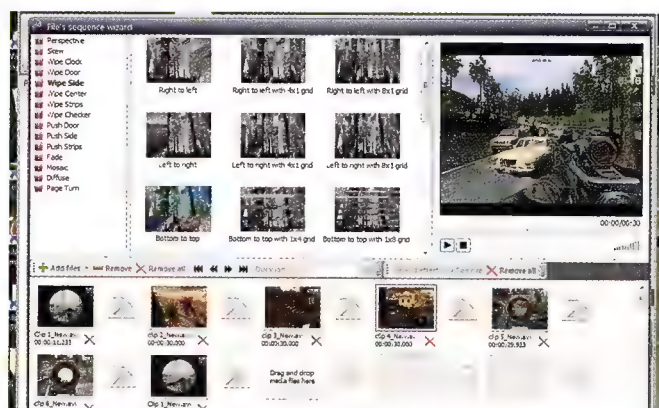
Video editing

Gather your clips together and start composing your masterpiece.



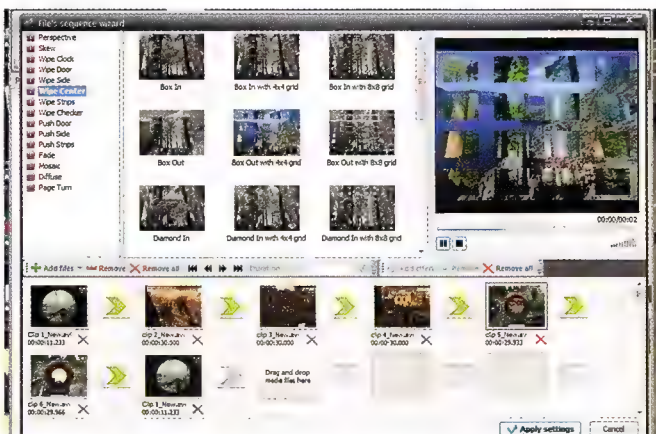
1 NEW PROJECT

Begin by selecting 'New project'. Your first job is to define your project's basic video settings, resolution, framerate and so on. It's best to set these to match the bulk of your source material, but don't worry about them too much right now — this is non-linear editing, so nothing is set in stone until you compile the final result.



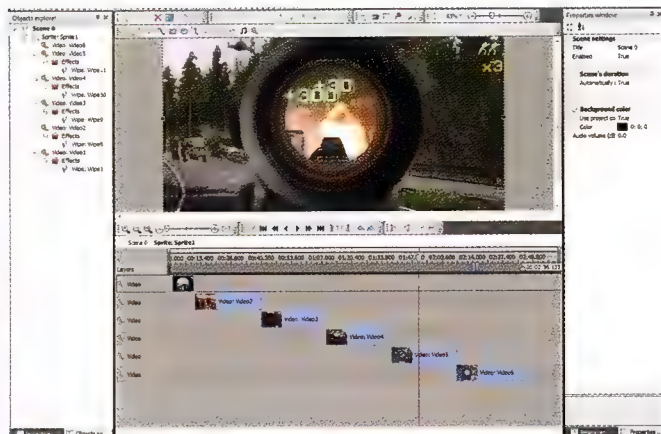
2 EASY WIZARD

Select 'Import videos and images' on the previous box, or choose 'Run wizard' from the Editor menu. Drag and drop your clips into the boxes at the bottom, or use 'Add Files'. I've thrown together a selection of *CoD4* footage of the player being heroic. You can highlight and preview clips to help you get them into the right order.



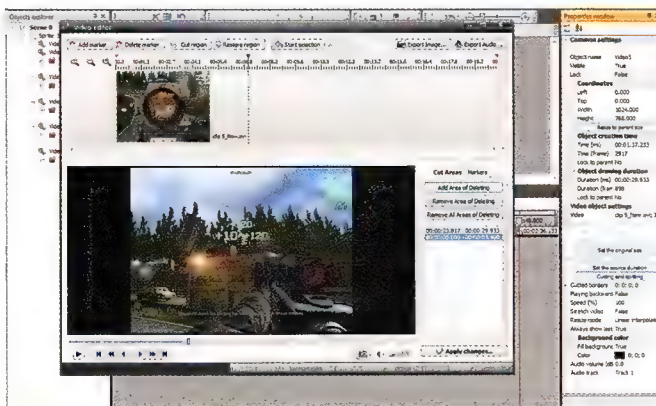
3 TRANSITION EFFECTS

The arrows between clips represent transition effects. Select a type from the list on the left, then select a variation from the right to see a preview. When you see something you like, drag it to the arrow, which turns green to show it's been defined. If you leave any unused, the transition will be a hard cut. Hit 'Apply settings' when you're done.



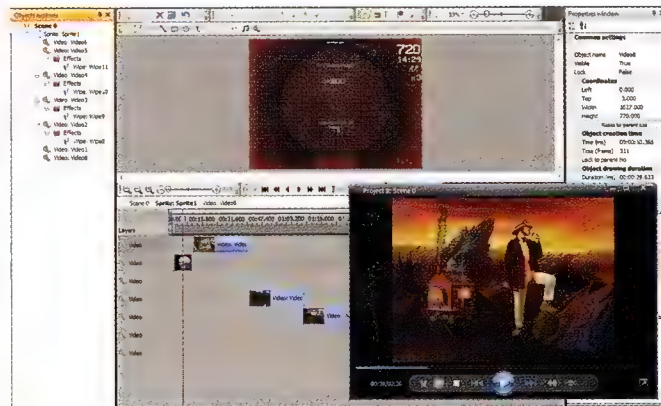
4 ONE BIG SPRITE

The main editing screen shows that you've created a single scene, in which the Wizard has created a sprite (an amalgamation of elements). Go the Scenes tab and hit 'Preview scene' to view it. Open the Objects explorer and open your sprite to see each element. Click the Sprite1 tab on the timeline to see the sequence of clips in full.



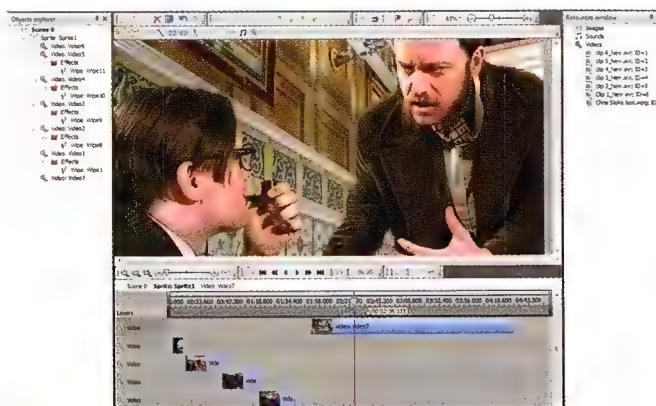
5 EDITING CLIPS

To edit a clip, select one from the timeline or explorer, open the Properties window and select 'Cutting and splitting'. Use the blue slider or video controls to select a starting point, hit 'Start selection', then move position again and select 'End selection'. You can now delete this section. Edits are non-destructive, and can be undone.



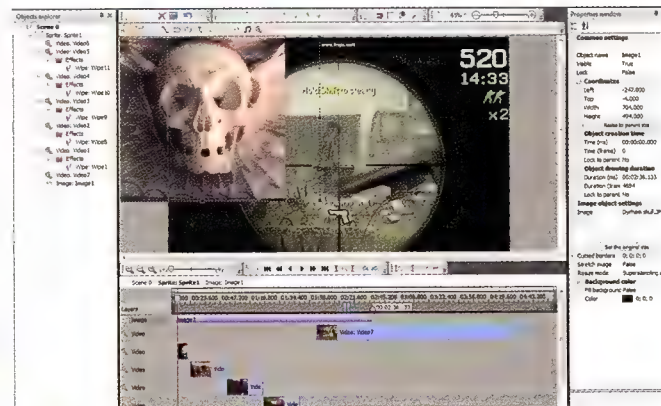
6 ADDING MORE

To add another clip, go to 'Add object', browse and select it. Open the Resources window and you'll find your new video clip listed. To add it to your scene, click and drag it to the working area (known as the mat) and select 'Add as video', then click and drag on the main edit screen to position it. If your sprite is open, it'll be added inside this.



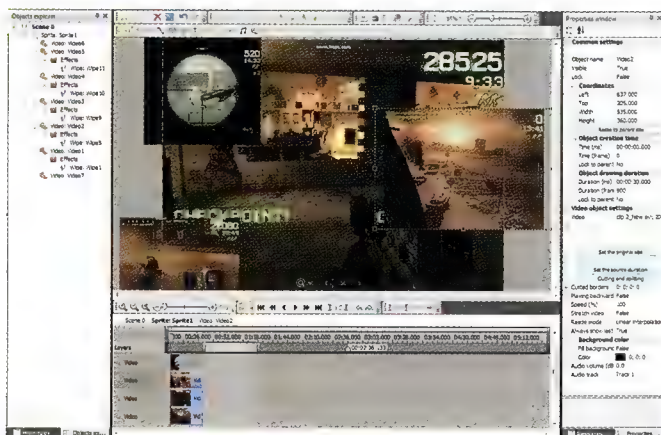
7 MOVING THEM ABOUT

Here's our sprite full of clips. The priority is top-down. To change this, right-click and move the video layers up and down. Click and drag to move about the timeline. It's best to divide long projects into separate scenes, which you can load and save separately. Use sprites to build blocks of edits and cuts, which can be moved as one.



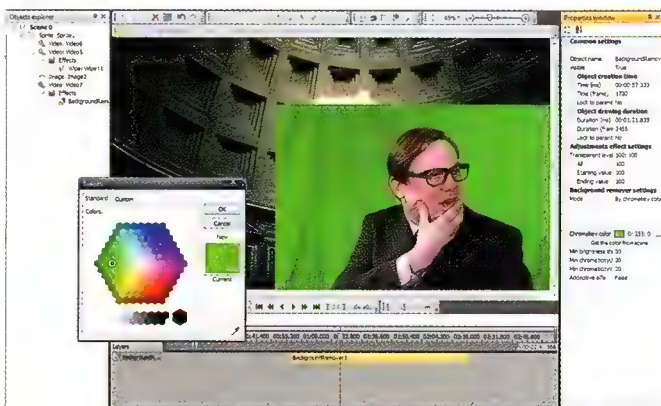
8 ADDING STILLS

Let's add a still. Click 'Add object' and select an image. This will appear in the Resources window. Click and drag it onto the mat. By default, it will overlay the whole sequence. Click and drag the ends to adjust the length, then click and drag the middle to position the still. Finally, click and drag the boxes on the main screen to adjust the size.



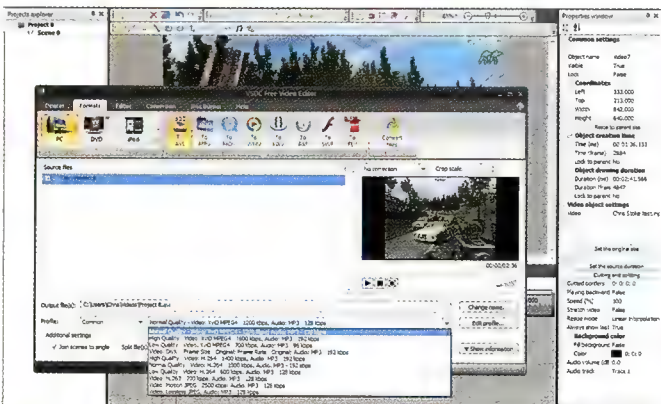
9 VIDEO OVERLAY

Use the timeline to stack two or more clips by sliding them over each other. Select the top one and click the main screen, use the sizing boxes to shrink it, and position it where you will. You'll find it useful to remove the background, so open the Properties window, click 'Fill background' and select False. Repeat to add more overlaid videos.



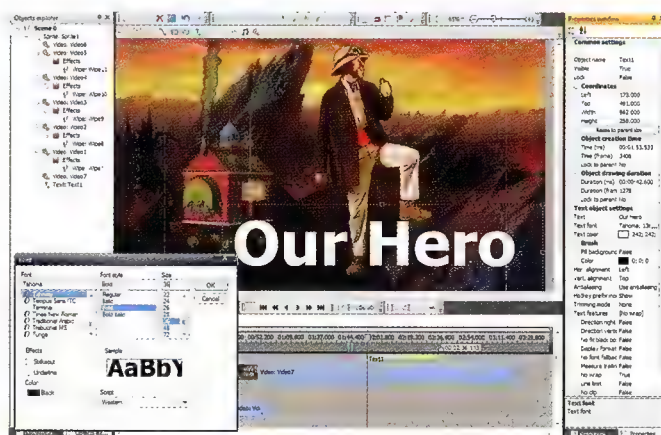
11 GOING GREEN

Load your clips and background, then position them with the green screen element on the top. Select the tab for your green video the timeline, go to 'Video effects' and select 'Background remover' under Transparent to add an effect layer. Go to its Properties window and use 'Get color from scene' to pick the colour to make transparent.



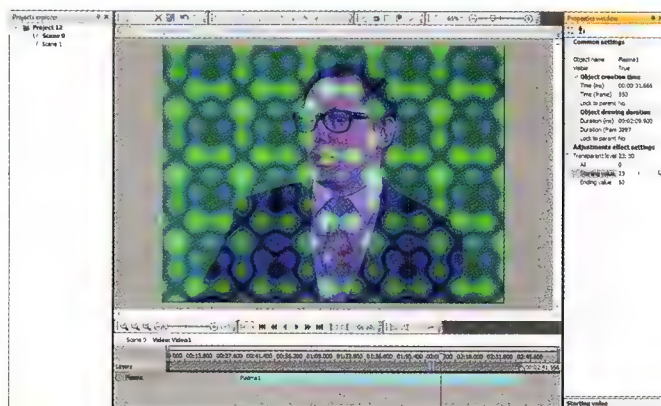
13 BUILD A PROJECT

Once you've finished, select 'Export project' from the Projects menu. The important bit here is the menu that lets you set the compression rate. This gives you various options depending on the device and format you've selected. Neat. Up to this point, all you've created is an edit list. This finally converts everything into a new file.



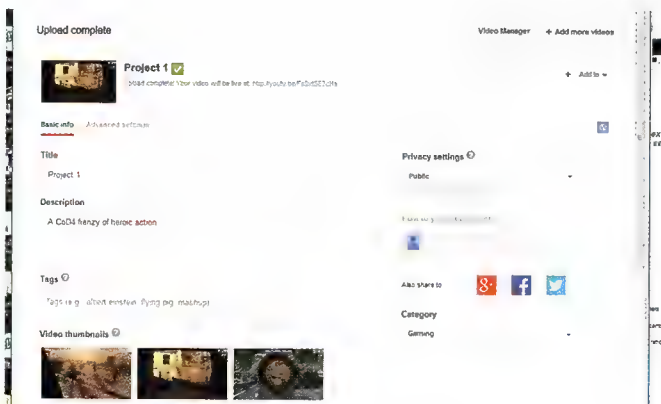
10 TEXT & SHAPES

You can also add text and basic shapes. Select 'Add object' as before. Choose Text, choose a position, and click and drag on your main screen to draw a text box. It's best to edit this box from the Properties window, so select the text and open this. You can set the text type under 'Text object settings'. It's a similar story with shapes.



12 SPECIAL EFFECTS

Each effect and filter adds a layer, which can be adjusted and edited. Load and select a video clip and click 'Video effect' under the Editor tab. This adds an effects layer, which is visible in the video timeline and under the Objects explorer. Adjust the settings with the Properties window. Here I've chosen the Plasma effect. Groovy.



14 UPLOAD TO YOUTUBE

YouTube converts videos internally into a format it likes. You can feed it .mov, .avi, .mpeg and so forth, but be aware that what you get out is not always what you put in. 1,280 x 720 is a good starting point for HD. It's all tied into Google+ these days of, course. Sign in and click Upload, then drag and drop. Don't forget to add appropriate tags.

Get it

Download the file you need for this article from www.apcmag.com/magstuff.

Macros for list management in Excel

Helen Bradley shows you how to create and view lists in Excel.

Excel's Custom List tool is a handy way to manage entering data into cells that you use frequently. While using the lists feature is easy, it isn't easy to determine what lists are available and the tool for making your own lists is buried in the Excel options. This month we'll create a macro which not only tells you what lists are available for you to use but which will create custom lists automatically for you.

THE SOLUTION

To create this solution, open a new Excel workbook and, in the VBA Editor choose 'Insert > Form' to add a new form. Place three option buttons and two command buttons on the form. Set the Captions for the option buttons to: Create List (from selected cells), List my lists and List all lists respectively. Set the Value property of the third OptionButton to True. The captions for the command buttons should be set to OK and Quit and you should set the Cancel property for the Quit button to True. Set the Caption property for the form to List management.

Choose 'Insert > Module' to add a new module and into it type this code to load the form:

```
Sub listManagement()  
UserForm1.Show vbModeless  
End Sub
```

Double click the Quit button on the form and enter this code to the CommandButton2_Click event:

```
Unload Me
```

Double click the OK button on the form and enter this code to the CommandButton1_Click event:

```
On Error Resume Next  
If OptionButton1 Then  
Application.AddCustomList  
Selection  
ElseIf OptionButton2 Then  
showlists (5)  
Unload Me  
Else 'this means  
optionbutton 3 is selected  
showlists (1)  
Unload Me  
End If
```

Then add a procedure in the form code area below the current code and type this:

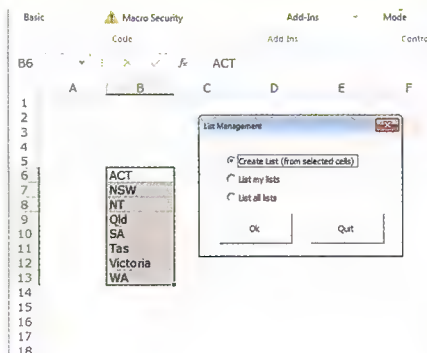
```
Sub showlists(liststart As Integer)  
usermessage = "Lists
```

```
are:" + Chr$(13) + Chr$(13)  
For mylists = liststart To  
(Application.CustomListCount)  
listarray = Application.  
GetCustomListContents(mylists)  
'find first and last  
list items  
firstitem =  
listarray(LBound(listarray,  
1))  
lastitem =  
listarray(UBound(listarray,  
1))  
usermessage =  
usermessage + firstitem + "  
... " + lastitem + Chr$(13)  
Next mylists  
If liststart = 1 Then  
MsgBox usermessage  
ElseIf Application.  
CustomListCount > 4 Then  
MsgBox usermessage  
Else 'user asked for custom  
lists only and there are none  
MsgBox "There are no  
custom lists"  
End If  
End Sub
```

Save the file as an .xlsm file and run the macro to test it. The modeless form stays open so you can type a list of items into a range of cells, then select the cells and add them as a new list. ■

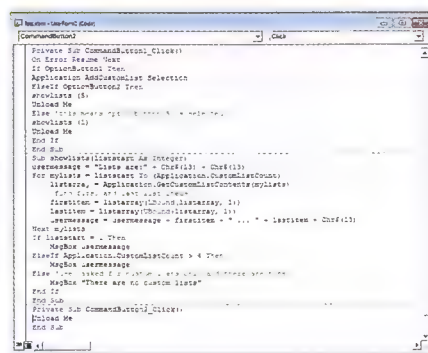
How to use it

Set up a custom list in Excel.



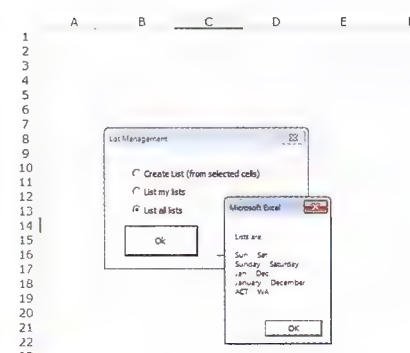
1 CREATE A LIST

The form has three option buttons and two command buttons. It is modeless so you can type a list into a series of cells to create a new list with the form still open.



2 RUN THE CODE

The code calls a subroutine allowing one piece of code to handle two different scenarios.



3 CHOOSE A LIST

Clicking either of the show list options displays a message box with the first and last item from each list so you can see what lists are available for use.

Building a 10W gaming system

Can you create a 10W gaming PC? Probably not, but Neil Mohr gives it a damn good go.



We're supposed to be power conscious these days. Our editor has unplugged his executive vibrating chair – for our mental sanity we're assuming it's the chair that's been vibrating. Our art editor had to swap his 1,000W 7.1 speaker setup for a pair of earbud headphones. While our tech monkey, Jeremy Laird, had to swap out his Intel six-core Extreme

Edition processor for Intel's latest Atom. And they're not even socket compatible people! (Oh the humanity.)

We can joke, but excessive power consumption is a real issue. Phones and tablets can idle at sub-watt levels, but even a modest PC gaming rig can happily suck down almost 200 watts of power without trying. If you're sat there browsing the web or furiously writing complaints about the

neighbour's Norfolk pines to your local council, all that power seems a bit of a waste of energy.

But what are the alternatives? You could jump on your laptop, but that's often still underpowered and you're left with an awful keyboard and trackpad to use, while upgrading it always feels a compromise. But then we did what our therapist told us not to do, we got thinking, perhaps we could

build a full-desktop system that was capable of 3D gaming but was also built around the idea of ultra-low power consumption? Perhaps even low enough to rival a laptop?

At the heart of this project is going to be a low power Intel Ivy Bridge processor that was going begging in APC Labs. It's built with a 22nm process and, in some ways most importantly of all, packs an Intel HD Graphics chip (the 2500), which means we can do away with power hungry third-party graphics cards for our system. Sorry AMD and Nvidia, you're out.

With so much integrated on to the super-efficient 22nm process, low-power states can be efficiently managed. While historically higher-power tasks now require far less juice as well, this is against a background of continued integration and ever more efficient processes; the number of ICs on a motherboard is down, the main chipset uses less power than ever and main storage and memory can be measured in a single watt. So let's see if we can get anywhere near that magical 10W mark.

When you think of PCs and power, you're more than likely thinking 800 watt power supplies, 125 watt TDP processors and multiple graphics cards, each of which could probably suck down enough juice to power a small Outback town.

That view of the PC world does exist and isn't even that uncommon. All the gaming rigs in our office are using that type of kit. Even a modest gamer is going to use a system that's sucking its way through a couple of hundred watts under load. Never mind someone like Jeremy Laird that's running Intel's latest six-core Extreme Edition kit.

You don't even have to go to those extremes to rack up a multi-watt power tally. Everything in a system adds up to the final power usage.

From all the ICs on the motherboard to multiple DIMMs in their many slots, to arrays of RAIDs, every component adds to the overall power draw. While the headline components like the processor and graphics card consume by far the most power, as we'll see when we start chipping away at the power consumption, suddenly every Watt of power becomes an issue.

We're not trying to demonise PC gamers and users here. On the contrary we love the high-powered rigs and the fact is these days the components come with reasonable power savings, enabling them to power down usually to a single Watt making them more environmentally friendly than ever.

The question we're asking is: can we have a decent desktop PC that's capable of modest 3D gaming with the latest games, but one that would have trouble powering an energy-efficient light bulb? Now that Intel has finally gotten around to producing usable integrated graphics, the answer to that question seems to be an emphatic yes. All that remains is figuring out how low we can go in power terms.

CORE EXERCISES

So for this month's PC Builder masterclass, we're going on a voyage of low-power discovery. Taking a look at why individual components have been chosen, why they're so much better than other choices and how they've managed to achieve such a low-power result. We're going to kick things off, as is often the case, with the processor, but for a couple of good reasons.

So we all know that when Intel introduced its Sandy Bridge processors it had finally introduced an integrated graphics solution that was just good enough to play the latest games. Something you could never say about older attempts, which seemed nothing more than afterthoughts to fill out the feature list. The crucial aspect of putting the graphics on-die with the CPU is that it all has to fit within the TDP of the processor package.

The processor is core to system performance, so when you're relying on it to provide the performance graphics end of the system too. Potentially, Haswell, Ivy Bridge and Sandy Bridge processors offer low-power models that could be used within a suitable system, it's just choosing the right one.

If you look up a table comparing the various Intel HD graphics models, you'll see that the 'older' HD 3000 offers 12 execution units at a higher 650/1,250 clock, while the HD Graphics



Viable iGPUs started with Sandy.

2500 in our Core i3-3220T has just 6 at 650/1,150. You would think this would lean us towards a Sandy Bridge packing HD Graphics 3000 model, such as the Intel Core i3-2105. But doing so trips you from the 35W TDP into the 65W TDP category as it's built on the 32nm process.

Opting for the 22nm based Intel Core i3-3220T provides a chip that retains a reasonable 2.8GHz speed with its twin cores and Hyper Threading but one that runs within the 35W TDP too. Opting for the HD Graphics 4000 or a faster 3.4GHz model bumps the processor up to 55W TDP. As it also turns out the revised HD Graphics 2500, while running half the number of execution units of the older HD Graphics 3000, manages better performance per-unit than the older model.

If we were going for low-power gold then the Intel Core i3-3217U that offers a tiny 17W TDP (or the upcoming i3-4120U at 15W) but still with an enhanced HD Graphics 4000 would be very tempting, until you realise the GPU clock is crippled at 350MHz. It actually tempted Intel itself, as this is the processor chosen for the Intel NUC mini-PC. Our main turn-off for this model is the low 1.8GHz main core speed, as we feel the extra 1GHz will benefit us in the long run for general tasks and gaming.

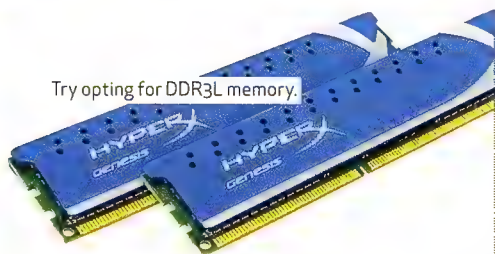
If we weren't going for lowest-power then certainly the Intel Core i3-3225 would be of interest. In a similar frame of mind, the name AMD hasn't so far been mentioned at all. That's because unfortunately when it comes to low-power AMD can't match Intel on the fabrication process technology. Dave James has previously pointed out that the AMD A10-5800K can slap the Core i3-3225 around in terms of GPU performance and pricing. But take a look at its TDP and it is 100W against the Core i3-3225 TDP of just 55W, while AMD can't build an A-series processor with a TDP below 65W.

MUMMY OR CHIPS?

Connected on a certain level with

The WD Green is a great 'big storage' option.





Try opting for DDR3L memory.

processor power usages is that of its particular chipset and motherboard. In the past motherboard chipsets have been surreptitiously power hungry. This was partly due to them being based on older fabrication processes. Added on top of that, older chipsets had to do a lot of donkey work which has now been integrated onto the more efficient processor die, and let's not forget the benefit of the integrated graphics element.

We've chosen the mid-range Intel B75 chipset, this has a TDP of 6.7W while it offers all the advanced ports you'd be after such as USB 2.0/3.0 and PCI Express 3.0. On a being nice to AMD note its A-series Fusion Controller Hubs or FCH are actually competitive on power, dissipating between 4.7W and 7.8W, this certainly wasn't always the case with the AMD 890GX chipset hitting 22W with its integrated Radeon HD 4290 graphics.

Contrast with say the classic Intel 945 Express, this provided DDR2 dual-channel memory support and was released back in 2005. It had a TDP of 15.2W and had to be accompanied by a South Bridge I/O IC to provide PCI, LAN and USB support. This added another 3.3W for a maximum of 18.5W. Similarly the Intel 915G with its integrated graphics pushed this to 16.3W with its South Bridge using 3.8W, which topped out at 20W just for the chipset, never mind the processor.

The motherboard we've opted for is the MSI B75IA-E33 mini-ITX based, as we've mentioned, on the Intel B75 chipset. Technically, we could have used a board with the Intel Z77 chipset, which has the same power dissipation as the B75, but these mobos tend to be fully-loaded high-end affairs and any extra ICs on there will add to the power requirements. So the super-slimmed version works for us just fine. Besides it offers everything you'd want output wise anyway.

INEFFICIENT SUPPLIES

We're all aware of gold-rated 85% efficient power supplies, right? Well, turns out they're not, under low-power conditions. That whole gold-standard only applies to a PSU under full load. Hook up a low-power system or just a standard system that's idling along while you, for example, consider your insignificant position in this infinite universe, and it's efficiency will tank.

What does that mean to you? It

means that a low-power system ends up sucking down more watts than it actually needs to and not even by a small amount, as we'll see. For testing we'll be using a gold-standard 850W PSU as a benchmark and older 275W Intel PSU to see how a lower power but unrated PSU can manage.

Lastly, we have a Pico PSU. This is an especially engineered, low-power PC PSU that is reported to be as high as 96% efficient. Its main disadvantages are that it's limited to 160W, uses an external power brick and has limited connections. While it does offer a full 24-pin ATX connector and the standard 4-pin ATX12V connector, it only offers a single SATA power connector and 4-pin Molex. There is an even lower-power Pico PSU option that omits the ATX12V connector, but for the modern PC systems we're after that's not an option.

PERIPHERAL MATTERS

We're not quite done with selecting components for our low-power system. Hard drives can add quite a lot of power consumption to an overall system. In a standard desktop computer a bank of four 3.5-inch spinning hard drives can actually consume upwards of 30 watts when under full access. Things are somewhat more subdued once they've spun down at 0.75 watts per drive.

Even SSD drives don't get away with a free power ride here. Power use on SSDs can vary as high as 6 watts under load. This is as high as a 3.5-inch spinning drive, so thinking it's solid state doesn't necessarily mean it's low power. We're running a Kingston V+200 SSD this is rated at 0.5W idle and 1.8W under load. The best on the market,

however, is the Samsung 840 Pro with a load power draw of a just 0.65W.

In contrast we're also testing a Western Digital Green 2.5-inch 2TB drive. This offers SSD matching power consumption, but without the capacity limitations while the retail price of \$270 roughly matches a higher-end 256GB SSD. The load power draw is a respectable 1.7W while idle is 0.8W.

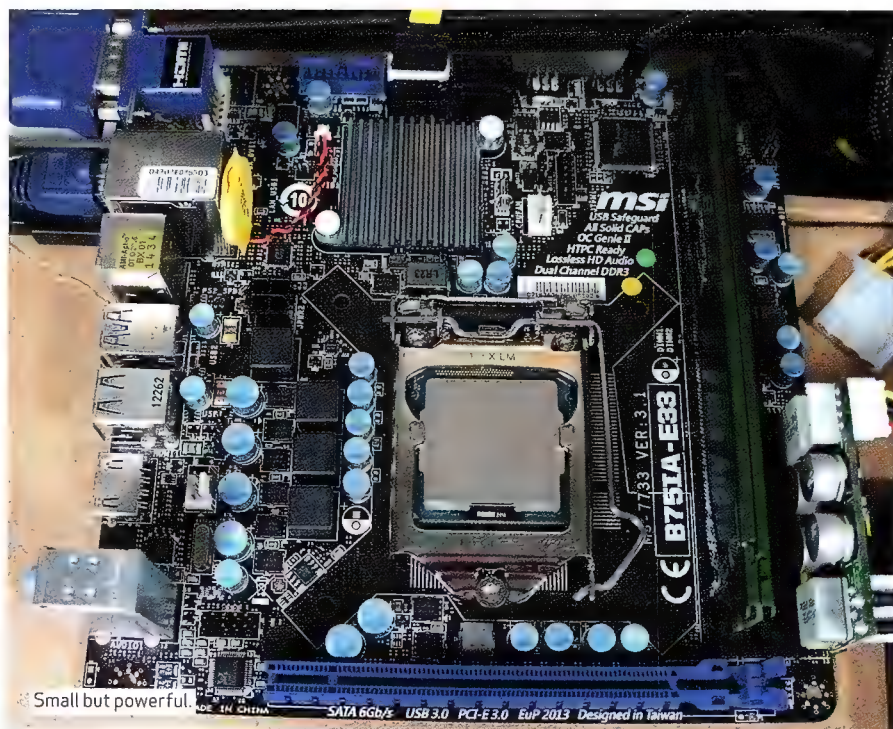
The last element we're looking at is memory. Obviously opting for a single DIMM rather than a dual configuration will help reduce the overall power required. Beyond this it's also possible to buy low-power DDR3. For the test we have an 8GB Kingston DDR3L DIMM that's rated at 1,600MHz and 1.35V rather than the normal 1.65V for DDR3.

DIDN'T HE DO WELL

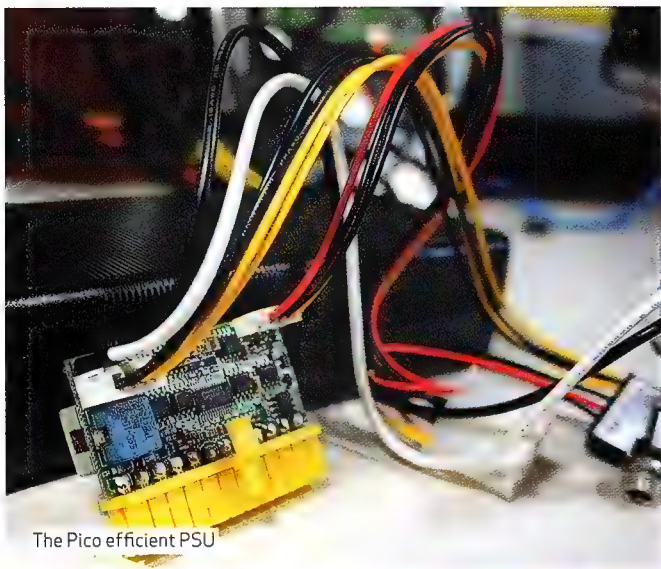
Plugging this all together, and powering it up off our standard test PSU a XFX 850W model, we were pleasantly surprised to read idle consumption of 22W and a game load of 36W. At this point we cracked out our Pico PSU and re-ran the system. Impressively, idle power consumption dropped to 15W an improvement of 32%, while load dropped from 36W to 25W again an improvement of 31%.

There was chatter that lower-power PSUs could fare better, so we tested an older Intel 275W PSU from a BTX system. Clearly the age of the PSU showed through, as the power draw of 28W at idle and 39W under load was significantly worse with the Pico PSU being around 47% more efficient.

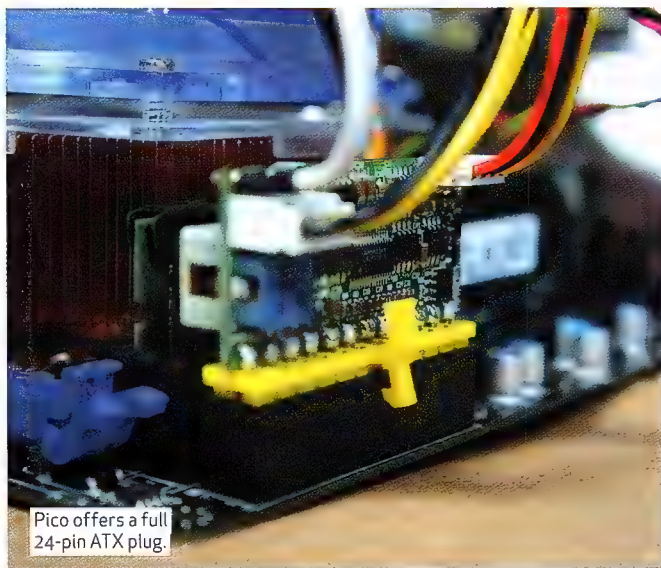
Of course, these initial results are through running the base BIOS settings. While many of the more useful voltage settings get locked out,



Small but powerful.



The Pico efficient PSU



Pico offers a full 24-pin ATX plug.

we can at least tinker with a few settings. It's odd the DDR3 memory defaults to 1.65V, we had already manually selected 1.35 volts, but we also kicked the memory bus down to 1,066MHz from 1,600MHz. We also turned off as many of the on-board integrated chips as possible, such as the LAN and audio.

Annoyingly, many of the voltages and even the QPI bus speed aren't accessible, as we'd certainly be tempted to undervolt the memory controller Vtt line, the memory VDIMM and main chipset PCH line. Underclocking the CPU from 2.8GHz to 2.0GHz had no effect on idle power consumption, we'd imagine as largely the processor powers down as much as possible no matter what the clock. Surprisingly, it also had no effect on the loaded power consumption.

All of this tinkering managed to drop the Pico PSU idle power consumption down to a mere 13 watts idle and 23 watts under a gaming load. Even adding the WD Green 2TB 2.5-inch drive to the system wouldn't see this rise above 15 watts. As a gaming rig it is going to leave something to be desired in the speed department, but the fact is, this is a system that can game if you need it to. At 13 watts idle we almost match our plucked-out-the-air 10W goal and frankly brought desktop power consumption down to laptop levels. We think that's pretty impressive, especially as we haven't had to compromise raw CPU power. ■

COMPARTMENTALISATION

Why we built what we built the way we decided to build it.

Throughout this feature we've covered why we've chosen certain components and why they're so good at saving energy. But it's useful to put everything down that we've used in one place and count up the beans for a final tally. While the final amount isn't too high, it's certainly not the cheapest system we've built and if you select a different set of components, largely AMD based, you are going to end up with a better performing gaming system. What you won't end up with, though, is better power performance.

It has to be said the Steamcom Pico PSU certainly made a huge difference and shows just how much juice a flabby PSU can waste at low power. At US\$240, however, it's a hard sell, especially when you can get a perfectly good standard PSU that's way more flexible for less than half that.

Beyond this main issue we're pretty happy with the Intel Core i3-3220T for the power levels it requires. As we point out ideally you'd like an Intel QS77 based motherboard, the only issue is no one seems to make one. But one of the micro-ITX B75 mobos will do the job almost as well.

We personally find the option of a WD Green 2.5-inch drive very tempting. With capacities up to 2TB it's going to supply most of the storage you could want on a system from a single 1.7w device. At that level it's competing well with most SSDs. Only the very expensive Intel 520 series does significantly better but that certainly sells for a premium.

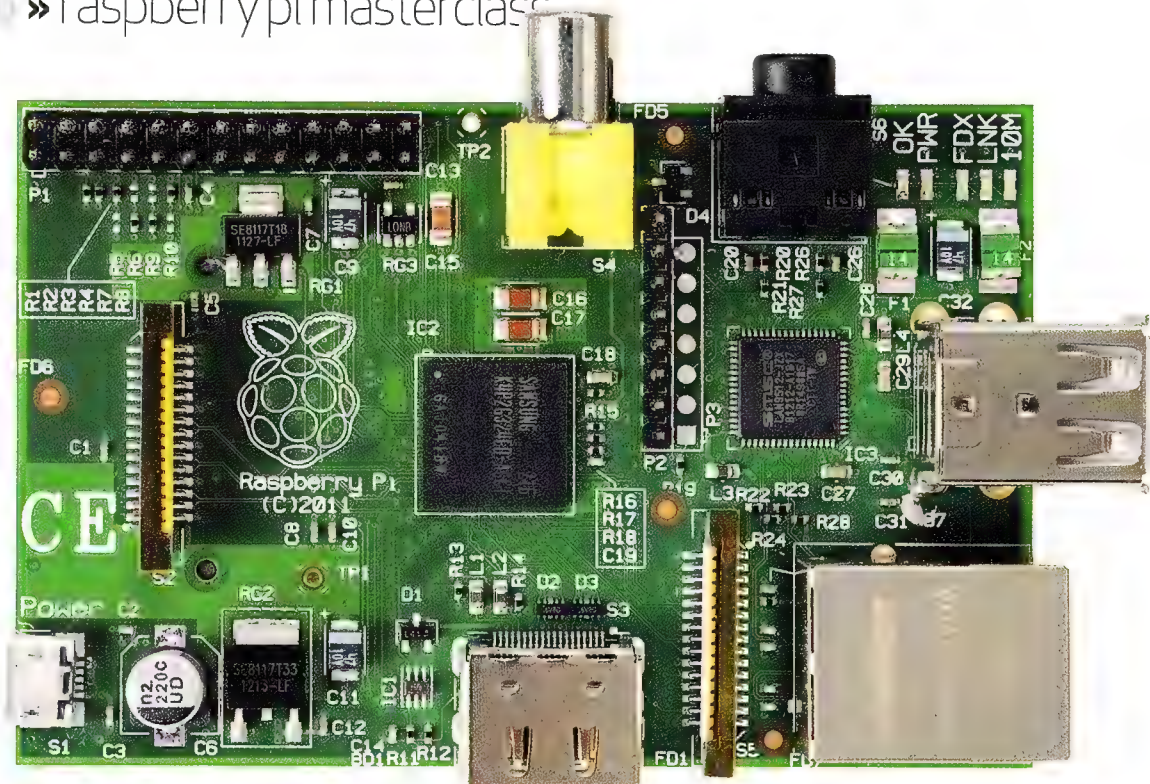
OUR LOW POWER RIG

INTEL CORE I3-3220T	\$170
MSI B75IA-E33	\$80
KINGSTON DDR3L 8GB	\$90
KINGSTON SSD	\$80
STREAMCOM PICO PSU	~\$270
TOTAL	\$690

INTEL NUC

INTEL "GOLDEN LAKE" NUC MOBO (INTEL CORE I3-3217U INCLUDED)	\$350
MEMORY 8GB	\$90
SSD STORAGE	\$80
60W EXTERNAL PSU	\$90
TOTAL	\$610





Getting started with the Raspberry Pi

Allow us to get you up to speed on this super diminutive device — it's a breeze to get going and you'll be a Pi pro in no time at all.

The eagerly anticipated Raspberry Pi arrived two years ago, and we still think it's great. In this tutorial, we'll start by providing an introduction that will get any user, no matter what their past computing experience, up and running. The topics we'll be covering include:

- What peripherals you need to buy
- How to create a bootable SD card in Windows
- What to do when the RPi system first starts
- What settings you might want to consider tweaking
- What you can (and can't) do with the Raspberry Pi now.

We hope that, whether you already have a Raspberry Pi or are thinking about buying one, this guide will show you what to expect and help you get off to a flying start.

Before ordering a Raspberry Pi, be aware that when it arrives it's just a green board with electronics soldered on to it. It's therefore missing a number of peripherals, including:

- USB keyboard and mouse for input
- SD card for storage (and an SD card reader)
- Ethernet cable to enable network

New Masterclass!

We've covered Arduino hacking and development for over a year now in *APC*, so we thought it was about time to give the other popular single-board PC — the Raspberry Pi — a look-in as well. This new Masterclass series will explain everything you need to know about how to get up and running with a Pi, as well as how to build some awesome Pi-powered devices.

- connection
- Power supply
- HDMI/composite cable for display, and the display itself.

PERIPHERALS NEEDED

This might sound like a nuisance, but meeting these extra requirements is simple most of the time. For starters, if you already own a desktop computer, you probably have all these bits and pieces lying around the house somewhere. If you don't, you can either buy a pre-compiled bundle when you order your Pi, or go to town and do a bit

of shopping. Before you open your wallet, though, read these notes to make sure you only buy components that are compatible with the RPi.

The power supply has to provide 5V/1A output and have a mini-USB connection. A new EU law means that many mobile phone chargers match these specifications, so check if yours does. For instance, we've been using a standard Android phone charger.

The SD card must be Class 4 and have at least 4GB of space available. Of course, the more space there is, the more applications and data you'll be able to keep on your Raspberry Pi. If you're unsure which to buy, you can find a list of cards known to work at elinux.org/RPi_SD_cards. You'll need to be able to read and write to the SD card from a computer other than the Raspberry Pi, so if your PC doesn't have a reader built in, you'll need to buy a USB one.

The HDMI/composite cable doesn't need to be expensive. Some shops sell very pricey gold-plated ones, but these are essentially a con. You can buy cables from some supermarkets for about \$10, which will work perfectly. As for which you need — HDMI or composite — that depends on what kind

of TV or monitor you have.

If you're hooking your Raspberry Pi up to a very old TV, you'll need to use a composite connection. This doesn't give the best quality – you certainly won't be able to harness the full resolution of the RPi – but it's almost universally compatible with TV sets. If your screen has a DVI connection, you should buy an HDMI lead and an HDMI-to-DVI converter, or a dedicated HDMI-to-DVI cable. If it has both composite and HDMI connections, you should opt for the HDMI, because this will give you the best possible image quality.

OS PRIMER

Not only do you need extra peripherals before you can get started, but the RPi is also missing an operating system. To make it work, you need to get hold of a compatible operating system and write it to the SD card using a special technique.

An operating system is the software that lets you interact with the computer. It receives your inputs, controls the hardware, and sends output to the screen or over the network. Ubuntu, Windows and Mac OS X are all examples of operating systems. Without an operating system, a computer can't do anything – it's just a big piece of inert metal and silicon. On a traditional computer, the operating system is stored on the hard drive. Every time you turn the machine on, the first thing it does is find the operating system and load it into the memory (RAM). The operating system then takes control of the hardware and keeps everything working until you shut it down. It's often said that the computer 'runs' or 'boots' from the hard drive.

The Raspberry Pi, however, is not a traditional computer and doesn't have a hard drive. Instead, it uses the SD card to store the operating system, all the other software you install, and all your personal data files. It runs from the SD card.

GETTING THE OS

To get the operating system on the SD card, you first need to download it. You can find the compatible operating systems on the RPi web site: www.raspberrypi.org/downloads. The developers recommend you download the Debian version for the time being, and this is what we're going to be using.

The download is 400MB+, so it will take a while on slower connections. There are other, slightly smaller versions, but they don't offer Debian's flexibility. Once you've got the image, you need to connect the SD card to the computer. If your PC has a built-in card reader, use that. If it doesn't, you'll need to connect a USB one.

The download is a .zip file, which you should extract. Inside the newly-created folder you'll find an .img file – it's this that needs to be copied on to the SD card, but it can't be copied like a normal file. The .img file, as the name suggests, is an exact image of a device. It contains information about the layout of data on the device and files used to boot the computer, which have to be in the right part of the drive. If you just copy it, the files won't be put in the right place, but will be stored on top of the disk's existing structures.

PREPARING THE SD CARD

Instead, we need to use a special program that will copy the first byte of the image to the first byte of the disk, the second byte to the second byte, and so on. On Linux, we can use a command line tool called dd to do this.

Put the SD card in the computer, then open a terminal window and type `df -H`. This command will display a list of all storage devices and partitions on your PC, along with their size, allowing you to find out what device label your computer has assigned to the SD card.

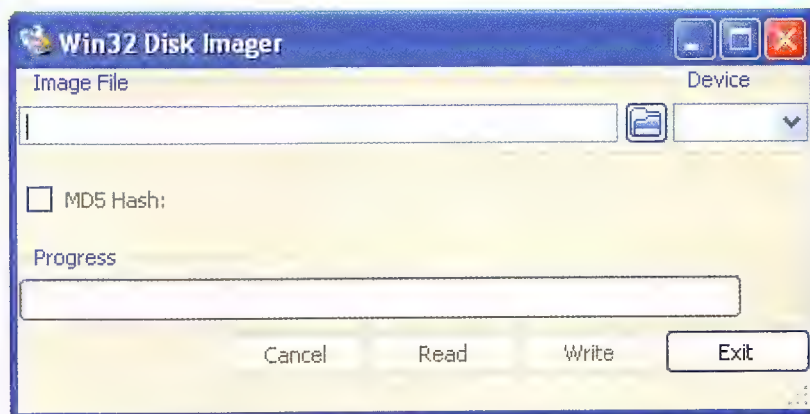
Look at each line and find an entry that has the same size as your memory card, and says 'Media' under the Mounted column on the right. Make a note of the information under the Filesystem column on this line, which should be something like `/dev/mmcblk0`.

Still on the command line, you need to enter the following (but read the rest of this article before pressing Enter):

```
sudo dd if=/home/jon/Downloads/debian6-19-04-2012/debian6-19-04-2012.img of=/dev/mmcblk0.
```

Here, the part that follows `if` should be the path to the downloaded img file. If you saved it elsewhere, enter the full path to that location instead. Where it says `jon` your username should be used instead. In this case, it's in the Downloads folder of our home directory. The part after `of` should be the part you noted down from the Filesystem column. If this looks like `/dev/mmcblk0p1`, remove the `p1` from the end; if it looked like `/dev/sdc1`,

"You should opt for the HDMI, because this will give you the best possible image quality!"



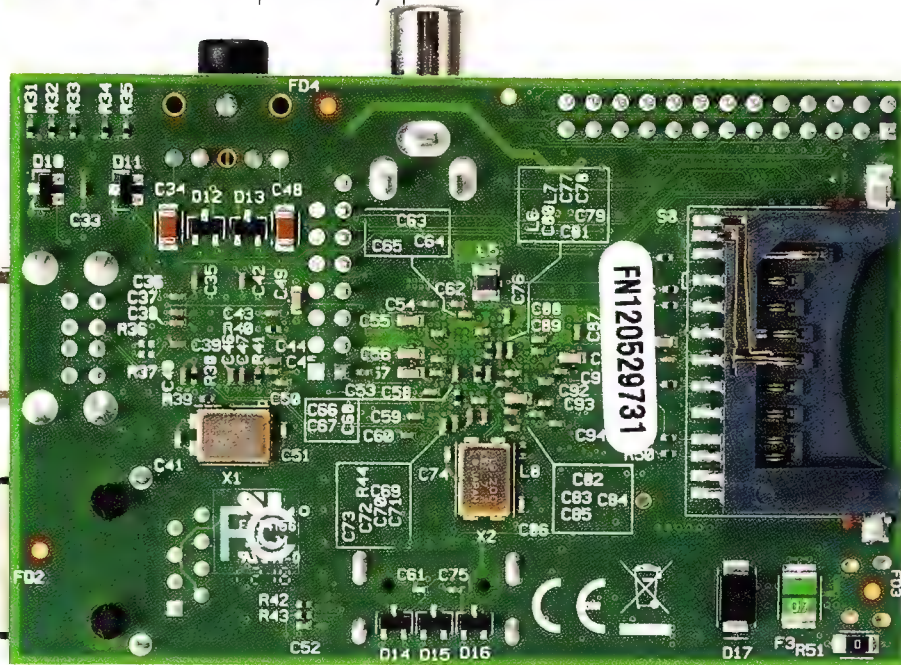
Writing the SD card in Windows

If you don't have a machine running Linux, you won't have access to `dd`, the tool we used to copy the operating system to the Pi's SD card, but you can copy the OS to the SD card in Windows using Win32DiskImager.

This tool was developed to work with the Netbook Remix of Ubuntu, but it has now become a popular tool for people playing with ARM devices (such as the Raspberry Pi). You can download it from tinyurl.com/cfvqd6. It's a simple tool.

Select the img file in the first field, and select the SD card from the Device field next to that. Then all you need to do is click Write to complete the process.

Make sure you get the correct drive, and consider backing up all your data first because it's possible to lose everything if you make a mistake. Also, as with `dd`, this tool will erase all information on the SD card, so be careful when using it.



"This removes all data from the device, so back everything up and check you get the right device."

remove the number from the end.

This removes all data from the device, so back everything up and check you get the right device. If you accidentally point `dd` at your main hard drive, you'll have problems.

BOOTING UP

Now, place the SD card in the slot on the bottom of the Raspberry Pi, and connect your USB keyboard and mouse,

and the display and Ethernet cables.

Then, with the monitor turned on, connect the power lead, and the Raspberry Pi should boot itself. You'll see a red power light next to the USB connections, and shortly after you should see some flashing green lights. If you don't, it means something went wrong with the SD card setup. Double-check the card is pushed into the slot properly, then reconnect the power;

if it still doesn't work, revisit the previous steps and configure the SD card again.

If all is well, you should see a lot of text scroll by on the screen with a Raspberry Pi logo at the top. The first time you start the Raspberry Pi, it will enter a one-off initialisation process. Along the way, it may stop loading when it says "Stopping Portmap Daemon"; if it does stop at this point, you can simply turn the power off and on again, and the RPi will start without any difficulty the next time around.

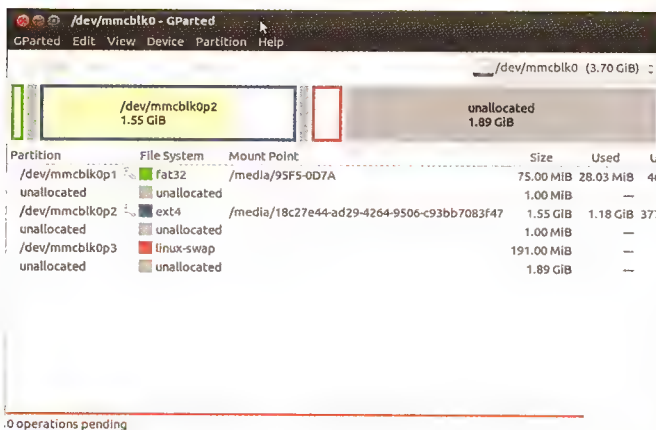
THE PROMPT

Eventually, text will stop scrolling across the screen, and there will be a line at the bottom that reads 'raspberrypi login:' followed by a blinking cursor. This is the login prompt, and it means the machine is waiting for you to enter your username and password. On the Debian image, the username is 'pi' and the password is 'raspberrypi'. Type the username and press Enter, then type the password and press Enter. It won't show your password as you type it, in case anyone is looking over your shoulder. After doing that, you'll find the text stops at another line. This time it reads 'i@raspberrypi:~\$' followed by a blinking line. This is the command prompt. The blinking line means the prompt is ready to accept your commands, which you enter by typing in the names of different programs, then pressing Enter.

If you plan to use your RPi to learn about computers and how they work, to run your own server or to do some programming, you'll spend more

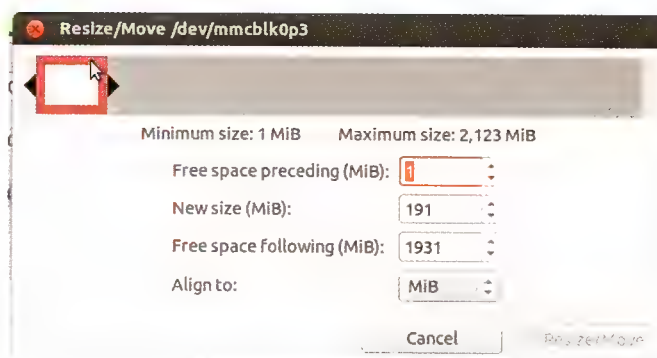
Take back the space

Get every shred of storage available.



1 PICK A CARD

Run GParted from your Linux distro. Look in the drop-down menu and choose a device that's the same size as your SD card. If it's the correct one, you'll see three partitions listed in the main window and two segments of unallocated space, as above.



2 MOVE IT AROUND

Now it's time to tell GParted what we want to do. Right-click the 'linux-swap' partition and select 'Resize/Move'. In the window that appears, drag the small box all the way to the right of the box that it's contained within. Click 'Resize/Move'.

disc contents

» OUR SELECTION OF EXCLUSIVE FULL-VERSION PROGRAMS

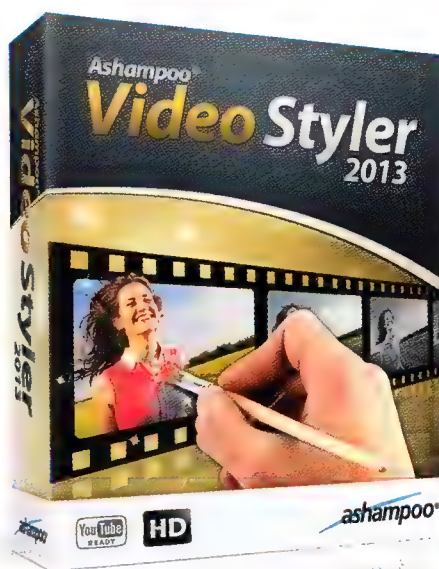
ISSUE 403, JUNE 2014

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SPECIAL VERSION

Ashampoo Video Styler is the ideal program to jazz up your videos. With its user-friendly program interface and many functions and filters you will easily turn your videos into impressive films. Apply one of the numerous filters or add background music to your video and make it an unforgettable memory with Ashampoo Video Styler.



SYSTEM REQUIREMENTS

- A DVD-ROM reader or burner.
- The APC disc is designed for use with up-to-date browsers (for example, Internet Explorer, Chrome, Firefox).
- The interface included on the APC disc requires a JavaScript-enabled browser.
- An internet connection may be required for online registration of software before use.
- The software packages on the APC disc have different system requirements. Software is included on the disc for Windows XP, Vista, 7 and 8.

BEFORE INSTALLING

- Check the disc using a virus scanner complete with the latest antivirus data updates. The disc was checked before burning, but new viruses are being discovered all the time.
- Back up any important system and data files. It is not recommended that the software contained on these discs be installed on production machines.
- If you have any questions regarding the use of the APC disc, click the 'Help' button at the top of the screen.

USING THE DISC

- Insert the disc into a CD/DVD-ROM reader or burner and your web browser should automatically load the interface. If not, launch your web browser and load the default.html file from the root directory of the disc.

HELP

- If you have any problems with the APC disc, please visit www.apcmag.com/disc.htm.
- APC provides no technical support for this disc or any software provided on it.



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time with the command prompt, but for now let's get the graphical interface working.

PRETTY PICTURES

At the prompt, type `startx` and press Enter. The screen will flicker for a few moments, then turn black, then a huge Raspberry Pi logo will appear with a taskbar across the bottom, similar to Windows. This is LXDE, the Lightweight X11 Desktop Environment. On Linux, and unlike MacOS X or Windows, users can choose from many graphical interfaces to interact with their computers. LXDE isn't the prettiest or most modern of these, but it's one of the leanest. This makes it perfect for running on hardware without much processing power or memory, just like the Raspberry Pi.

Have a play around and click the buttons to see what they do — you can't break anything at this point, and even if you did, you could just unplug and reconfigure your SD card.

Although you can't see the command line any more, it's running in the background. Access it again by pressing Ctrl-Alt-F1. You should see some obscure-looking text following the `startx` command you issued. This is the output from the running program, the X Server.

X is the program that Linux uses to control input devices and display information on the screen. It creates a series of virtual consoles, accessed by typing Ctrl-Alt-F1 to F6. The graphical environment — on the Pi at least — is always accessible on the console, represented by F2. Therefore, to get

back to LXDE, just press Ctrl-Alt-F2. One thing you might notice as you play and explore is that the desktop doesn't fit your display properly. This is a common problem that some people using HDMI connections have found. It's caused by something called overscan, which is a hangover from television sets from the 1930s through to the 1990s.

FIXING THE PROBLEM

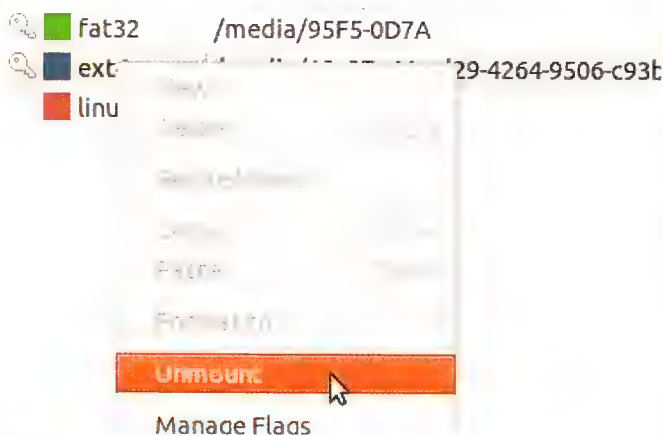
To fix it, we'll return to the command line. We won't switch virtual consoles as we did before — we'll use a terminal emulator instead. Open the LXDE menu by clicking the icon in the bottom-left of the screen, then click 'Accessories > LXTerminal'. This is another way to access the command line. Into the prompt, which appears in a new window, you need to type `sudo leafpad /boot/config.txt`. This will launch another new window — a text editor called Leafpad. You don't need to open a file, because the command you entered also specified which file Leafpad should open to edit — `config.txt` in the `/boot` directory. Into here, type `disable_overscan=1` and then save the file. You can then reboot your Raspberry Pi by clicking the logo in the bottom-right of the screen, and when it comes back on, the screen should be filled.

There are a lot more options you can put in this file. A lot of these have to do with display modes such as resolution, but some cover modifying how fast the processor runs — overclocking it, essentially. You should avoid these, as they could damage the computer, although with something this cheap,

perhaps it's worth the risk. The `hdmi_drive` option is useful if you're using a HDMI to DVI converter. Set it to 1 to ensure your screen is at the correct resolution and reboot.

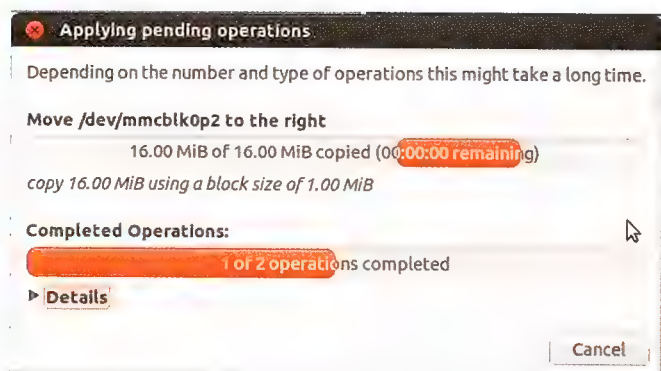
At this point, you've got your Raspberry Pi running, you know how to start the graphical interface and you've set the screen resolution. There's one more tweak we want to describe before we finish, though, and that's how to configure your SD card to make all its storage space available for files and software. The reason this is necessary is that when you put the `img` file on to the SD card, it automatically divided the drive into three parts. Each of these appears to the computer as if it were another physical hard drive, and is known as a partition. One of these is used for storing the operating system and all your files (known as the root partition, represented by a `/`), another is used for providing virtual memory (known as the swap space) and the third is used for storing the files that let the Raspberry Pi start. Because each is seen as another physical device, if there's room on the SD card that's outside of these partitions, the operating system will ignore it.

The Debian image we put on the SD card creates a root partition that's always the same size. As a result, on our 4GB SD card we found ourselves with 2GB of unused space, and only a few hundred megabytes available to store our new applications and files. To fix this problem, you'll need a Linux machine with GParted installed. You can then follow our step-by-step guide, above. Remember to back up your data before you get stuck in. ■



3 MAKE SOME ROOM

Right-click the 'ext4' partition, select 'Unmount', then right-click and select 'Resize/Move'. Drag its right-hand edge to the end of the box to resize it. Click 'Resize/Move'. This finalises the moves we want to make, but nothing has been done yet.



4 ALL DONE

If you're sure you've got it right, click the green tick at the top of the screen, then wait patiently while GParted moves and resizes your partitions. Now take the SD card out, stick it in your Raspberry Pi and power it up.

Have a need for speed?



Looking for a wireless router that delivers super-fast speed?

How does wireless speeds as fast as 1.3 gigabits per second sound? Well, hold onto your seats because Billion's new BiPAC 8800AXL wireless AC broadband router offers just that! Based on a Broadcom chipset, the BiPAC 8800AXL supports ADSL2+ and is fibre-ready, using an Ethernet Wide Area Network port to hook into the NBN as soon as it comes to your house. It also has four additional Gigabit Ethernet ports plus two USB 2.0 ports, allowing for 3G/4G modem connectivity, print serving or Network-Attached Storage.

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- ultimate wireless speed 300+1300Mbps
- SNR adjustments to achieve highest sync speeds
- monitoring of individual LAN/WAN traffic
- QoS for traffic prioritisation and bandwidth management

3 x faster
than the
current
Wireless N
protocol

Speeds up to
1.3 gigabits
per second

For further information on the Billion BiPAC 8800AXL or for a full list of Billion stockists Australia-wide, visit billion.com.au.

DIY Chromecast alternative

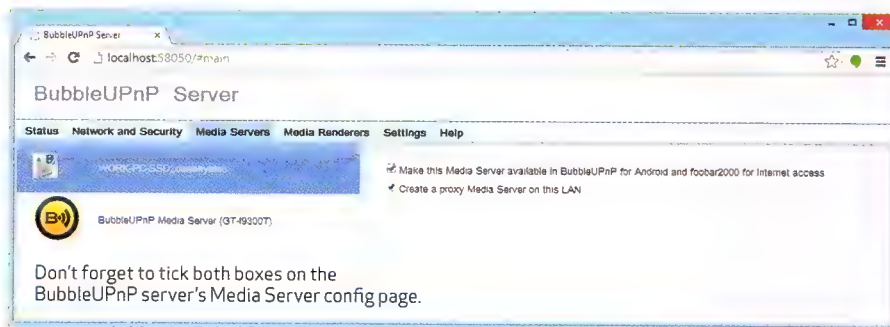
Google's Chromecast dongle isn't the only way to remotely stream your media content to your big screen. As Darren Yates explains, alternatives are everywhere.

Back in the 1992 hit movie *Sneakers*, Ben Kingsley's character Cosmo somewhat prophetically tells Robert Redford that future power is all about the information, "little ones and zeros, little bits of data". Today, those little ones and zeroes may well be king but we're equally interested in finding new ways to fling them around our homes, networks and the internet. Chromecast is Google's attempt at delivering a low-cost remote streaming dongle and word is, it's arriving in Australia early May.

It's certainly not the only way to go about it, though – last month, we looked at how you stream Netflix into Australia via your Android phone and even stream it wirelessly to your TV using Miracast, all without a Chromecast dongle. But if you have a sizeable investment in your own content library and prefer an option to handle your own movies and music, this month, we'll show you how any Android device can become a Chromecast clone.

DIAL-A-PROTOCOL

The Chromecast dongle is a single-core ARM-class Wi-Fi-ready mini PC running a cut-down version of Chrome OS and

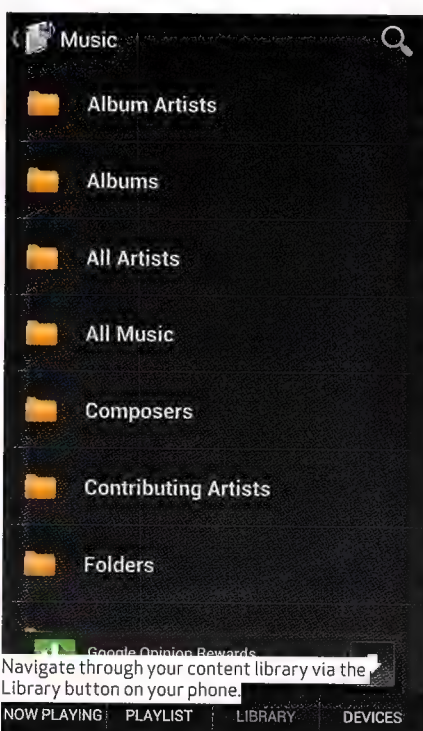
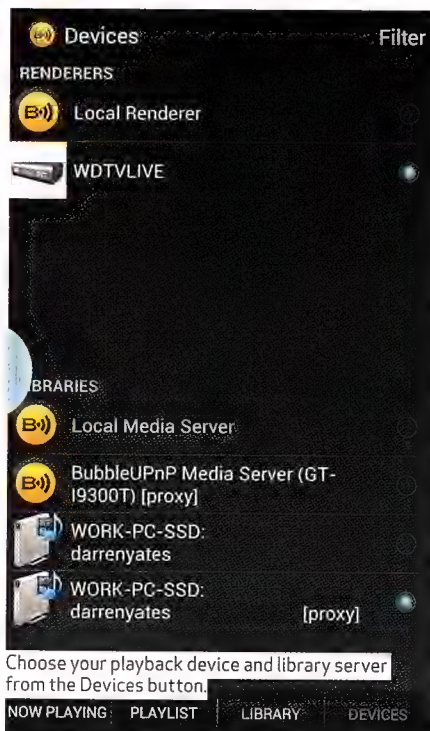


uses a new network discovery protocol called DIAL (Discovery And Launch). Co-developed by Netflix and YouTube with input from Sony and Samsung, the protocol is said to make it much easier to launch second-screen apps (apps that reside on one device but are launched and displayed on a second). The key to DIAL is that it's open-source and is touted as being a serious competitor to Apple's proprietary AirPlay system.

But the reality is, it's another media protocol trying to gain market traction – apart from DIAL and AirPlay, you also have DLNA. They're all variations on the theme that is universal plug 'n' play (UPnP), the original protocol designed to get PCs, network devices and media players to work together.

The DLNA protocol has gained a reputation for being a bit fickle, particularly with the audio/video codec support you can expect. While that can be true of function-limited home entertainment gear, there's some extra wriggle room when it comes to more intelligent devices like mini PCs, tablets and phones.

DLNA has been around for a long time and it has support in a wide variety of devices from Windows PCs to Xbox gaming consoles to network media players. But there are various UPnP tools and libraries also available for Android and with the right apps, you can get any Android-powered device to work like Chromecast with your own content.



"But the reality is, it's another media protocol trying to gain market traction."

WHAT YOU NEED

With Chromecast, the two key parts are the dongle and the controlling app. In making your own Chromecast-lookalike, you'll need three — the device connected to your telly replacing the Chromecast dongle, the controlling app and a DLNA-ready network server holding your content library.

One Android DLNA app we've recommended in the past is BubbleUPnP as a great way of viewing your media library directly on your device without having to load it on beforehand. It's also a pretty decent option for Chromecast-style remote viewing and controlling. BubbleUPnP is both a renderer and controller, at least in terms of audio, but it's smart enough to offload video rendering to more capable video apps and that gives you considerable versatility in how you build your Chromecast-like setup.

MIX & MATCH

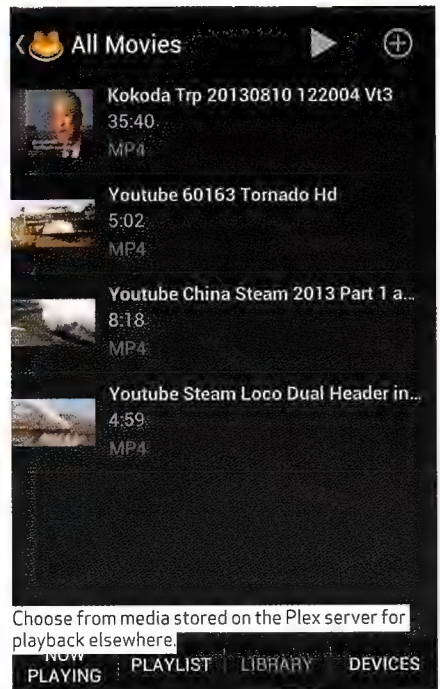
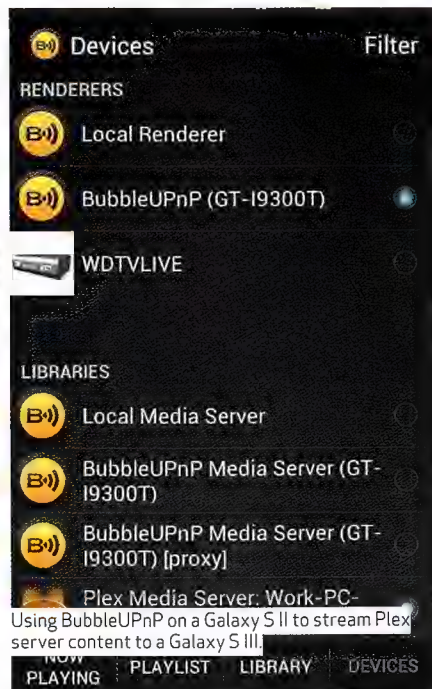
Apart from rendering and controlling, BubbleUPnP also has a separate server component, giving you the trifecta and allowing you to create your own perfect home media setup with the one app family. But DLNA is fairly broad when it comes to controller capabilities, not only casting rendering jobs to other DLNA apps, including itself, but other devices such as the WDTV range.

We've spent a fair amount of time this month trying out various combinations, mixing and matching different devices with a range of apps, all controlled by various Android phones. The results are surprisingly good, good enough that with just a few dollars in app purchases, you likely already have everything you need to get your own Chromecast-like setup off and running. Here are just three of the successful combinations we tried:

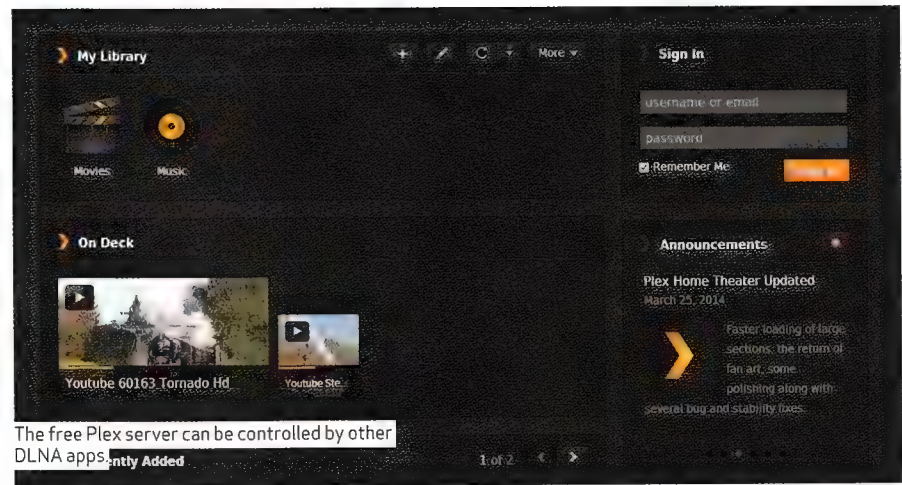
- SETUP 1**
- CONTROLLER**
- BUBBLEUPNP ON SAMSUNG GALAXY S III**
- RENDERER**
- WESTERN DIGITAL WDTV LIVE**
- SERVER**
- BUBBLEUPNP ON WINDOWS 8 PC**



Western Digital's network-capable WDTV series can also act as renderers.



Choose from media stored on the Plex server for playback elsewhere.



Other options

Spoilt for choice.

Basically, anything that can run an ARM-class CPU and Android should be useable as a Chromecast-like DLNA rendering device, so if you have a mini PC such as an MK802 or MK808 device, it'd be definitely worth giving it a go. Just for a laugh, we tried a cheap 7-inch A13MID tablet we bought off eBay a couple of years ago — you can still find them for well under \$50. With a 1.2GHz single-core CPU, we expected it to handle music; we weren't so confident about video. But we had DVD-resolution video MPEG-4 video streaming to it using Setup #3 and playing perfectly — no obvious dropped frames and audio in sync. The key is using MPEG-4 video hardware acceleration — it's built into virtually all Android-powered CPUs.

The first step in any Chromecast-like build is to setup your server, which in this case, we did on a Windows PC. We used the BubbleUPnP server app, free from tinyurl.com/c95thqd. Download and install it — you'll also need the Java runtime engine (JRE) but it should automatically install it for you. Once the installer finishes, the server should be up and running and launching its own browser-based config page. If not, you'll find it at <http://localhost:58050>. You'll need to open it, choose the Media Servers tab and click both checkboxes — without the second 'Create a proxy Media Server on this LAN', you'll likely get access denied errors on your controlling device.

Next, install BubbleUPnP from Google Play on your Android device. Launch the app and you'll see the basic menu on the bottom. Tap Devices and you'll get a list of Renderers and Libraries. Provided your WDTV Live is powered and network-connected, you should see it on the Renderers list — tap

Audio/video codecs

Keeping in mind that any video transcoding or conversion is one process too many when it comes to maintaining video quality, you should aim for a media entertainment setup that supports as many video codecs as possible so nothing needs to be transcoded. That said, if you need to pick a format as close to universal as you can get, go for H.264 video and AAC audio — they're in and supported by almost everything.

We even had success using this \$45 A13MID Android tablet as a renderer.



Netgear's PTV3000 Miracast adapter connects easily to Samsung's Galaxy S III phone.

the radio button next to it. The Libraries list at the bottom will show available DLNA servers. Tap the radio button next to your PC proxy entry.

With that done, tap on the Library button on the bottom row and you should quickly get a menu list of your music, photos and movies. The good thing about the WDTV Live is that it plays just about everything, so you shouldn't have too many issues with audio/video codec support.

Tap through the folders, make your selection, press the menu button and create your own playlists if you wish. When the file starts playing, you can control it by pressing the 'now playing' button in the BubbleUPnP app. Use the timeline to scrub through the file, the buttons to pause, stop or go onto the next track/file.

SETUP 2

CONTROLLER

BUBBLEUPNP ON SAMSUNG GALAXY S II

RENDERER

BUBBLEUPNP ON SAMSUNG GALAXY S III

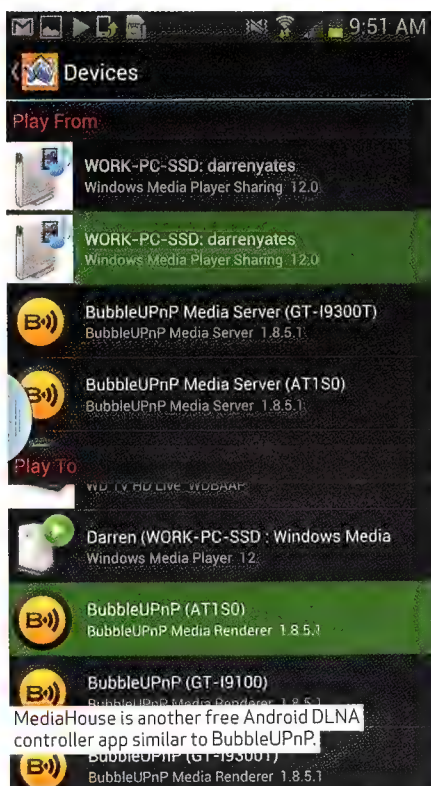
SERVER

PLEX MEDIA SERVER ON WINDOWS PC

The Galaxy S III smartphone has been a huge success for Samsung and even though it's now a bit long in the tooth, it's still being sold by at least one local carrier on new budget contracts. With Samsung's own quad-core Exynos 4412 processor on board, there's more than enough horsepower to render any 1080p video content.

Using BubbleUPnP as its own renderer is fine for audio, but you need to install a good video player for your movie collection — the app we like to recommend is MX Player. It's free from Google Play and handles a decent array of codec options by default. Anything it can't handle can be supplemented by the ARMv7 Codec Pack, also free from Google Play.

What made this setup more interesting was the cross-pollination we achieved between BubbleUPnP and the popular Plex media server. Plex gives away the server free but charges \$5 or so for the Android app, but you can save your money and use BubbleUPnP instead. We had no trouble getting the app working with the Plex server on music but it proved a little sluggish handling video — it worked, but slowly. With Galaxy S III automatically routed



MediaHouse is another free Android DLNA controller app similar to BubbleUPnP.

to use its AllShare Cast/Miracast output, we had a fully wireless solution displaying audio and video to our Netgear PTV3000 Miracast dongle. (Of course, you could use the Galaxy S III as its own controller – we used the Galaxy S II here just to show that this can be done too).

The first time you use BubbleUPnP as a renderer, you may need to manually set it so that it knows to use MX Player to play the videos. Just go into BubbleUPnP's menu on the Renderer device, select Settings and 'Local Renderer'. Scroll down and make sure 'Launch default player' is selected, restart and you should be ready to go.

SETUP 3

CONTROLLER

MEDIAHOUSE ON SAMSUNG GALAXY S III

RENDERER

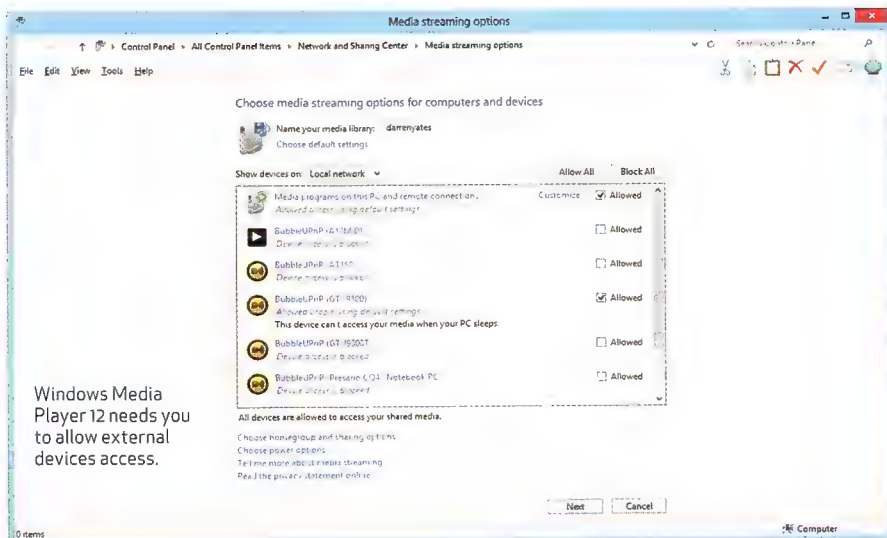
BUBBLEUPNP ON TOSHIBA AT1S0 7-INCH TABLET

SERVER

WINDOWS MEDIA PLAYER ON WINDOWS 8 PC

It's a fact that many people are happy to use Windows Media Player as DLNA server. If you're the happy owner of an Xbox 360 or Xbox One gaming console, it's relatively trivial getting them to play your content – provided it's encoded with MPEG-1/2/4 or WMV7/8/9 codecs.

But you can tap into that content with other DLNA-ready devices, including your Android smartphone and tablet. BubbleUPnP is a bit of a 'jack of all trades' in this area, but it's not the only option – we decided to give MediaHouse



Windows Media Player 12 needs you to allow external devices access.



a run (free on Google Play) to see if we could get it to send content from WMP on a Windows 8 PC to BubbleUPnP on a now-ageing Toshiba AT1S0 with a dual Nvidia Tegra 2 processor.

Rather than 'renderers' and 'libraries', MediaHouse uses the rather more intuitive 'play from' and 'play to' – and it works a treat.

The AT1S0 was one of the first 7-inch tablets on the market and although it did have some goofy features (like the huge power connector that didn't include USB connectivity and very ordinary speakers), it did come with a microHDMI port, making it dead-easy to connect to a big-screen TV. The AT1S0 also highlights that you don't need the latest Android gear to make this work – it came with Honeycomb/Android 3.2 but now has an Ice Cream Sandwich/4.0.4 update. That said, the majority of apps we've looked at are happy with Éclair/2.1.

One tip – you may find that due to Windows security, you'll need to allow access to various external DLNA controllers before you'll get access to any WMP content. Launch WMP12, press the down-arrow next to Stream

under the top menu and click on 'More streaming options'. You'll now see a list of DLNA-ready apps on your network – just check the box against the ones from your devices. Click Next to check which media folders are shared, click Next again, ignore the passcode (that's for Windows Homegroups) and click the Finish button.

TRY THEM OUT

Bottom line, there are any number of ways to build Chromecast-like functionality into your media setup and the great thing is, many of those options are free, or can use your existing gear – or both.

We think BubbleUPnP is good enough to do the whole job – control, render and serving. But throw in MediaHouse, Windows Media Player, Plex, WDTV Live and there's no real script – you can make it up as you go along. And that means you're not locked into anything and have full control over how your setup works.

But really, if you're not driving your home entertainment remotely from your Android smartphone or tablet, you're not trying hard enough! ■

Digital audio recorder

This month, Darren Yates shows you how to get an Arduino Uno board to record digital audio to a flash card from scratch.

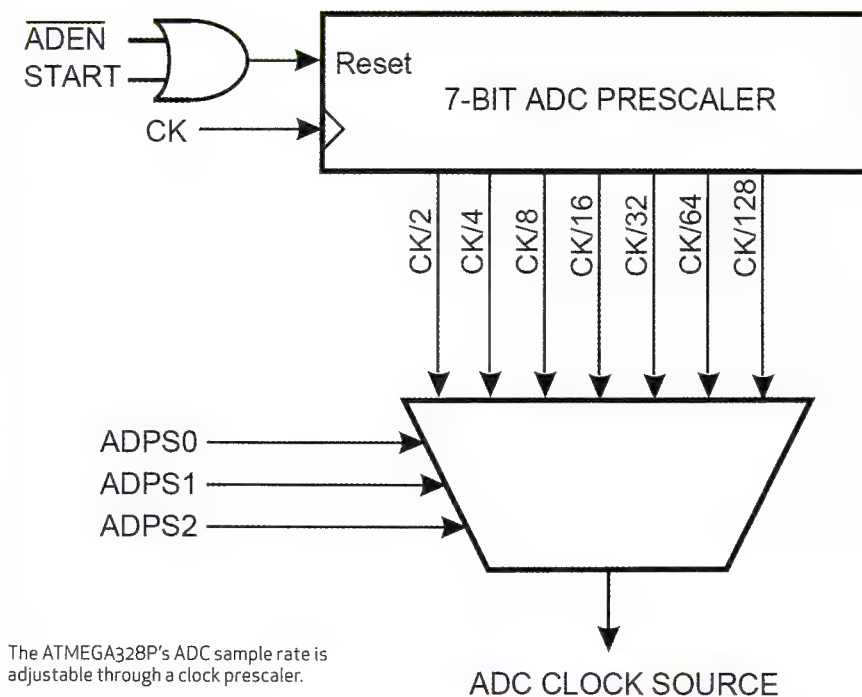
I have to admit to being a bit of an audio buff and have been since I was a kid – the concept of being able to capture sound, store it and play it over and over again never fails to leave me in awe of its pioneers, from Thomas Edison to lesser-known luminaries such as Alan Blumlein, the British electrical engineer who, in 1931, invented ‘binaural recording’ – what we now call ‘stereo’.

So far in this series, we’ve turned an Arduino into a number of audio-related projects. This month, we see just how far we can push the popular microcontroller as we begin from scratch turning it into a basic digital audio recorder.

HOW IT WORKS

No matter what they look like, all digital audio recording devices have to perform the same basic functions – capture an analog audio signal at regular intervals while at the same time, saving the digital data to storage. That might be easy for a PC or smartphone, but we’ll need to introduce some advanced programming techniques plus tap into some hidden features to get this working on an Arduino Uno.

Our Digital Audio Recorder will capture a single (mono) analog audio channel with a sample rate of 22.05kHz, 8-bit sample depth and store it as a Windows WAV file with up to 4GB filesize on a microSD flash card. Now before you yawn in excitement at those specs, remember, we’re doing this with a 16MHz processor, just 2KB of RAM and



The ATMEGA328P’s ADC sample rate is adjustable through a clock prescaler.

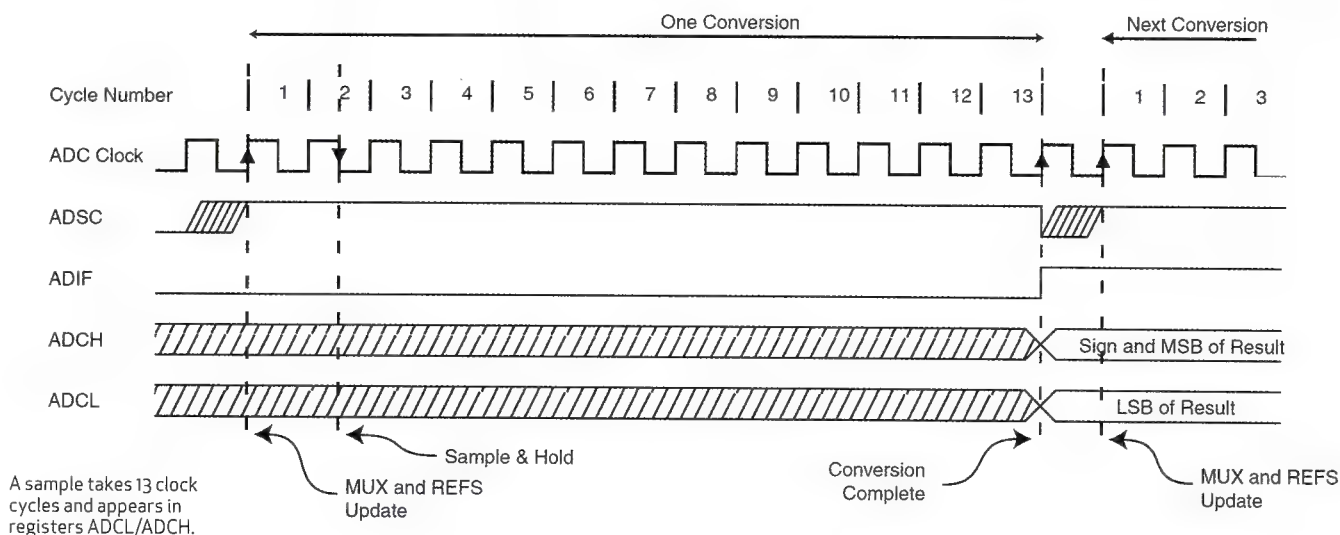
32KB of programming space. If only a Windows PC could be so efficient!

To help make the project (and source code) as easy to understand as possible, our recorder has just two buttons – record and stop. It doesn’t play audio and only records to a single fixed file in the root folder of the flash card called ‘REC00000.WAV’. An existing file with the same name will be overwritten. For playback, just take the flash card, load it into your PC, phone or tablet and play the file in any standard WAV file-ready media player or editor.

NYQUIST THEOREM

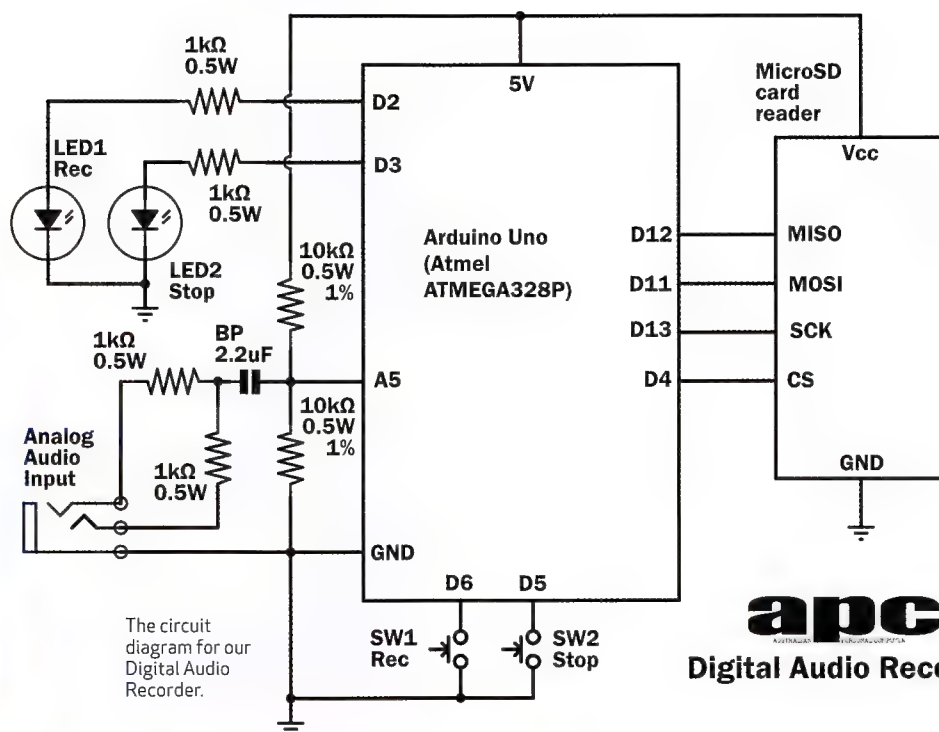
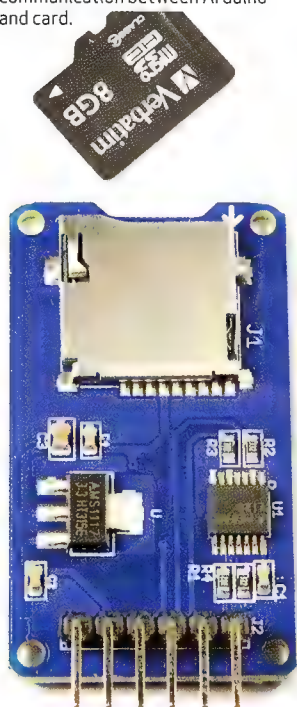
We all know digital audio – we all listen to music and we’ve all no doubt ripped a few CDs in our time. But how do we capture an analog signal and turn it into digital audio?

This is where the work of another electrical engineer, Harry Nyquist, helps us out. He figured out that in order to digitally capture an analog signal, we need to capture it at regular intervals, a rate which needs to be at least twice the highest audio frequency we want to capture. That means if we want a 5kHz



A sample takes 13 clock cycles and appears in registers ADCL/ADCH.

This \$5 microSD reader handles communication between Arduino and card.



The circuit diagram for our Digital Audio Recorder.

apc
Digital Audio Recorder

audio bandwidth for example, we need a minimum 10kHz sample rate.

The way we capture those samples is with a circuit device called an analog-to-digital converter (ADC) and the Arduino Uno's ATMEGA328P microcontroller chip has one on-board. By default, it has a 9.6kHz sample rate and 10-bit sample depth, so we already have work to do to knock it into shape. For starters, the sample rate is too low (we'd only get a 4.8kHz audio bandwidth, which is AM radio at best) and the bit depth is the wrong size. (Bit depth is the sample precision, normally 16-bit in CD audio, but the Arduino's ADC only has 10-bits to start with).

Still, the ATMEGA328P has a few tricks up its sleeve. One of those we used in the Audio Spectrum Analyser project is an adjustable ADC clock prescaler. Just like any CPU, the ADC requires a clock signal to synchronise its function and here, this is set by a programmable divider or 'prescaler', dividing the 16MHz Arduino master clock by a default factor of 128 to create a 125kHz ADC clock rate. Because the ADC uses the successive approximation sampling method, each sample takes 13 clock cycles, giving us a sample rate of 125kHz/13 or approximately 9.6kHz. But if we reduce the prescale factor, we can increase the ADC clock rate – a prescaler factor of 16 cranks up the sample rate to nearly 77kHz, or a sample every 13 microseconds.

But there is a downside – the ADC loses sample accuracy with increased clock speed, however, even at this higher rate, the accuracy is still close to 8-bit, which is all we need. This overclocking technique works

Get it

Download the source code you need for this article from www.apcmag.com/arduino.htm.

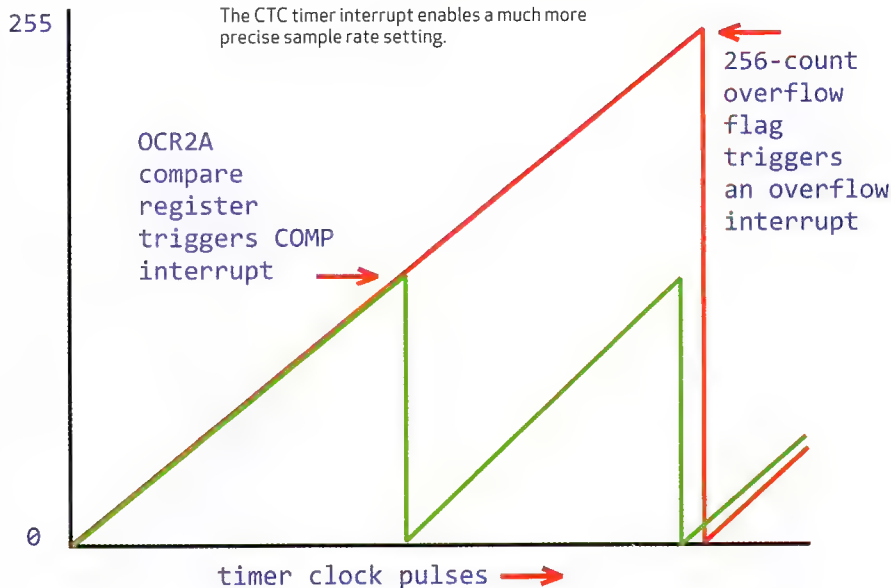
extremely well, but there is one other major limitation – the limited number of prescaler settings leaves us with audio-unfriendly sample rates of 9.6, 19.2, 38.4 and 76.8kHz, none of which are WAV format-standard.

Read through the ATMEGA328P datasheet and you'll find that in addition to the normal free-running

sample mode, the ADC also has a single conversion mode, whereby the ADC is enabled by setting the sampling register bit or flag, it grabs that sample and immediately resets the flag when the sample is ready for processing. That mightn't sound like cause for celebration, but when we combine it with another of the ATMEGA328P's hidden talents called timer interrupts, we now have a mechanism for setting a much more precise sample rate.

TIMER INTERRUPTS

In computer architecture, an interrupt is a trigger to tell the processor to immediately divert from the current process and run a specific task. Once the



Clear Timer on Compare Match (CTC) interrupts

new task is completed, the processor returns to the original process and picks up where it left off.

Now, the ATMEGA328P has all sorts of interrupt triggers to play with – you can trigger an interrupt externally by pulling an interrupt pin high or low as appropriate, but the chip also has a number of software-controlled options, one set in particular called ‘timer interrupts’.

In any CPU or microcontroller, a timer is just a hardware variable or register that counts up to its maximum count (for example, 256 for an 8-bit timer), instantly drops back to zero and starts again. Because timers run off the master clock and each count takes a fixed number of clock cycles, we can programmatically figure out how long it will take to reach the top count, hence the timer name. The ATMEGA328P has three of them – one 16-bit and two 8-bit timers – along with different ways you can use them. One simple way is once the timer reaches its maximum count, it can set an overflow flag, which can be used to trigger an interrupt. Like the ADC, timers also have a programmable prescaler for the input clock, so we can adjust how long it takes to reach that overflow condition.

But another far more useful option is a special mode called ‘Clear Timer on Compare Match’ or CTC. Instead of waiting for the timer to reach its overflow point, we can choose our own – for example, rather than wait for an 8-bit timer to count to 256, we can load any number between 1 and 255 into a special compare register and once the timer reaches that number, it triggers an interrupt, the timer instantly reverts to zero and counts again. Using this technique to drive the ADC sampling, we can set the sample rate with far greater precision.

In our project, we use the chip’s ‘Timer2’ timer, switch it to this CTC mode and load an 8-bit register called ‘OCR2A’ with our compare number to

The project components, including card reader, fit on this DIY prototype shield.

give us an interrupt every 45 microseconds. That gives us a sample rate of approximately 22.19kHz – not perfect, but closer than anything else.

STORING THE SAMPLES

However, now we have these 10-bit samples turning up every 45 microseconds, we’ve got to do something with them. The first thing is to drop the two least significant bits (LSBs) and turn them into 8-bit samples – that’s relatively easy since each 10-bit sample is split and stored in two 8-bit registers ADCL and ADCH. We program the ADC control register ADCSRA to give us just the top eight bits in the ADCH register.

But with only 2KB of RAM on-board (closer to 1KB by the time we run our code), the ATMEGA328P will still run out of space in a heart-beat – that’s

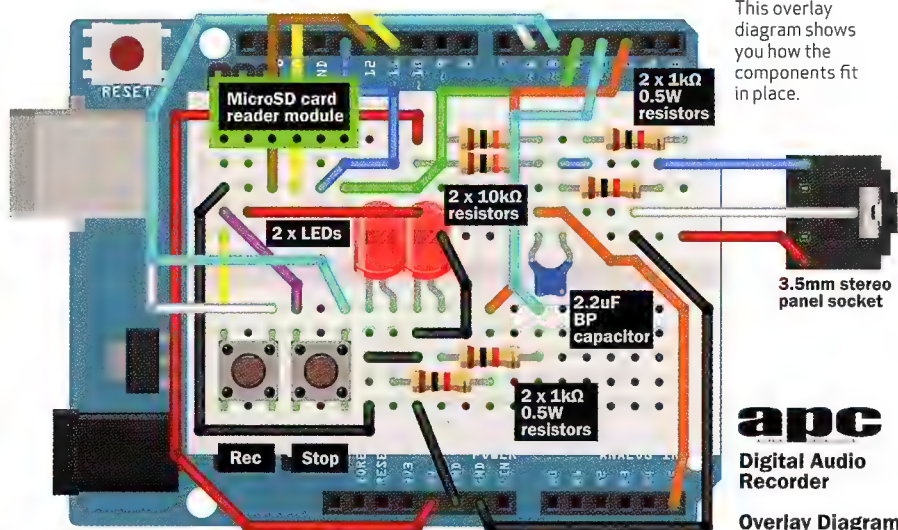
where the microSD card module comes in to play.

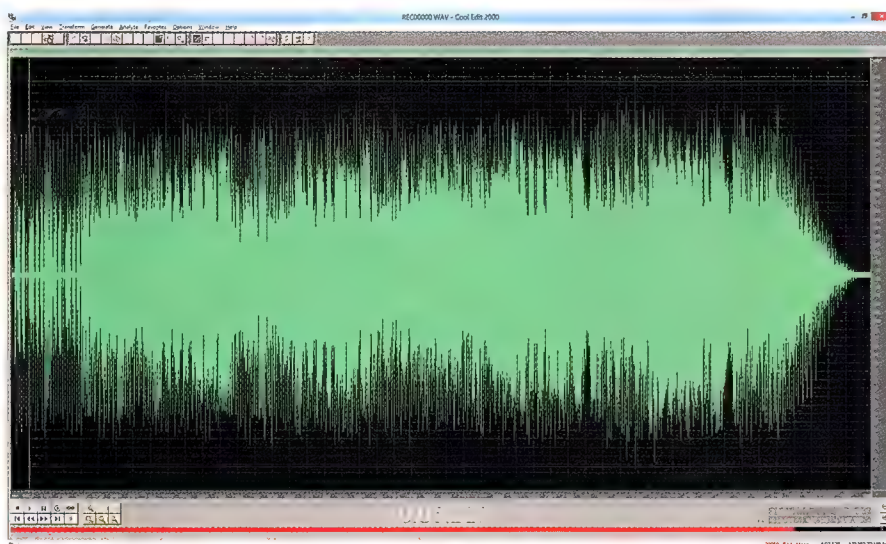
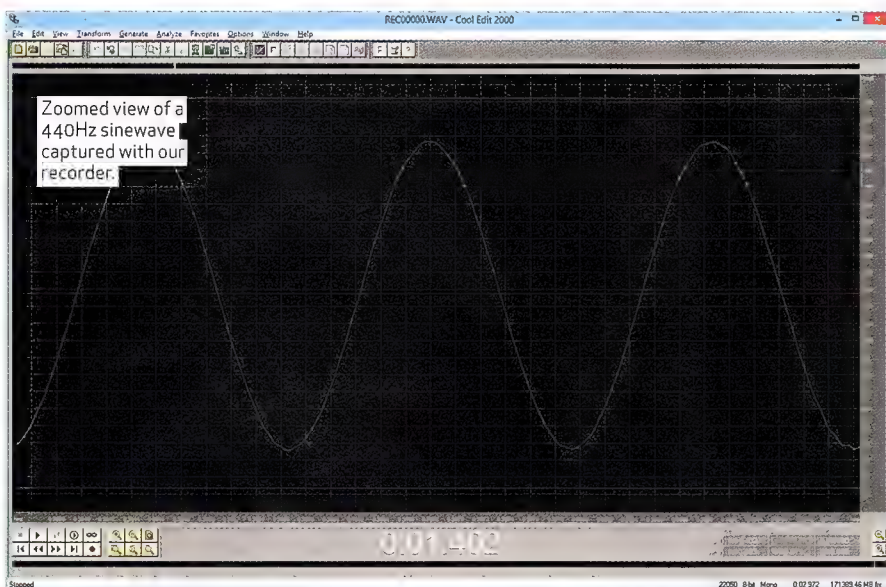
We all know SecureDigital (SD) flash cards – they’re in everything from cameras to phones and tablets. We load them into our PCs and they appear as yet another storage drive. But when it comes to low-level hardware design like this, we need to understand a lot more about these tiny little storage devices.

All SD cards normally use a four-bit wide parallel interface to transfer data and achieve average write speeds beyond 10MB/second. But the key word is ‘average’ – the actual write speed can vary considerably, depending on the latency or delay in writing data to the card. Normally, your PC or device has sufficient RAM to buffer the data and smooth out the writing process so there’s no perceived loss in write speed. But the ATMEGA328P has two things working against it – it only has 2KB of RAM, but more importantly, it doesn’t have a 4-bit data interface. Instead, we have to use the one-bit Serial Peripheral Interface (SPI) bus. It’s the fastest interface the Arduino Uno has, but even running at 8MHz, it leaves us with an average write speed of only 150KB/second.

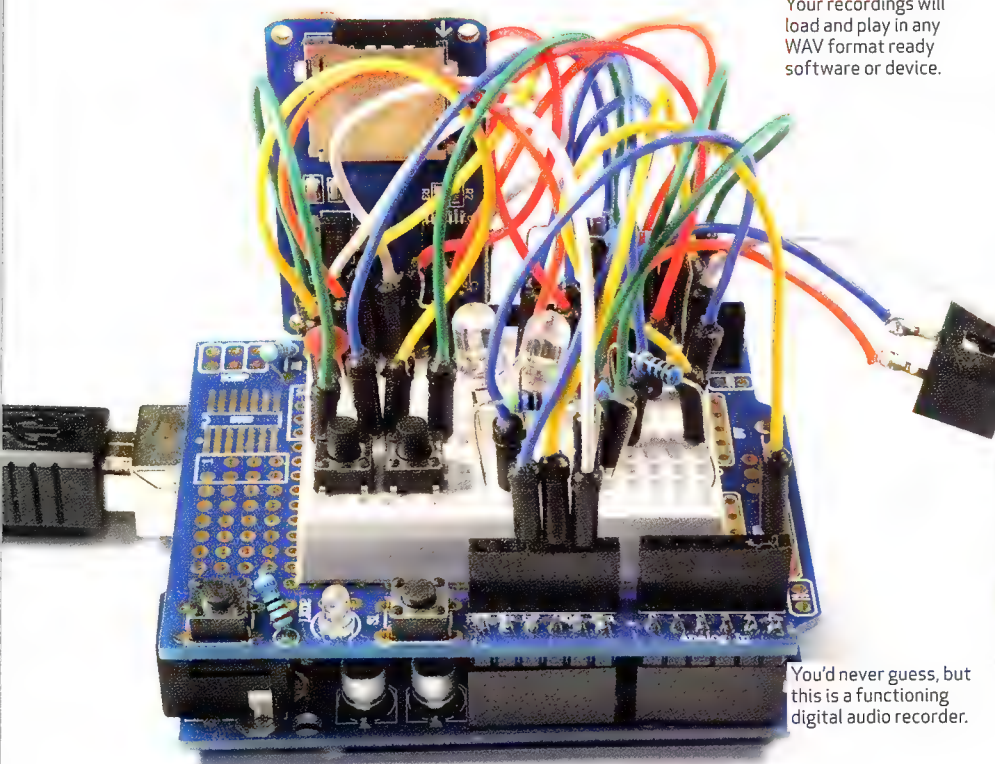
Since we only want to store 22.05 (22.2) KB per second, it sounds like we’re fine, but again, this SPI-bus write speed is an average. SD card storage is divided into blocks, each 512 bytes wide, so we have to write the data in 512-byte chunks – but that write process can’t interfere with the ADC sampling every 45 microseconds. The problem is, average SD card latency in SPI mode is between 700-900 microseconds.

The simplest write method we could





Your recordings will load and play in any WAV format ready software or device.



You'd never guess, but this is a functioning digital audio recorder.

Listen to history in the making

We've been recording sound since Thomas Edison invented the tinfoil system in 1877. Check out cylinder recordings at www.youtube.com/user/THEVICTROLAGUY/videos. Alan Blumlein's stereo test recordings from 1933 have also been preserved and restored by the British Library. Listen online over at tinyurl.com/k8aqrkj.

try is to just open up a file on the card, start grabbing samples, count them up as we go and when we hit 512, dump that block to the card using the sample interrupt routine. But if we do that, we'll still be writing the block when the next sample interrupt request arrives — and that'll result in either new samples or the entire block being lost.

TWIN BUFFERS

We solve this problem using a technique commonly found in digital audio design called 'double buffering' — we set up two 512-byte blocks of RAM called buffers, labelled 'buf00' and 'buf01' in our code. As we start recording samples, we store them in the first buffer. When that buffer is full, we switch over to the second buffer; meanwhile, the first buffer is now saved to the flash card. The 512-byte buffer size gives us roughly 22 milliseconds to get that first buffer written to the flash card. The 900-microsecond average latency for SD card writes via SPI is way too long to handle inside the 45-microsecond sample interrupt process, but with 22 milliseconds per buffer to play with, we can get the ATMEGA328P to multitask and write the block in between ADC samples.

Once the second buffer fills up, we switch back to loading up the first buffer again that has now been saved and meanwhile, start saving the contents of that second buffer in the next 22 milliseconds. What we end up with is this constant swapping — we're storing samples in one buffer while writing the other buffer to the flash card. But on the card itself, we end up with a seamless stream of audio data, all done with just 1KB of RAM. (In reality, the Arduino's SD library grabs its own 512-byte buffer, but without our double-buffering, this project wouldn't work).

NEXT MONTH!

That's all we have space for this month. Next time, we'll continue by looking at how the WAV header works and look at all of the source code tricks that make this project possible. ■

downtime

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The Elder Scrolls Online

A satisfying themepark for the massively at heart.



Every modern *Elder Scrolls* game has had a moment near the beginning where you step out into a new landscape and think "I've never been somewhere like this before!"

I have spent around 80 hours playing *The Elder Scrolls Online* and I'm still waiting for that moment. I'm waiting for the point when this MMO sits up and makes a claim to be anything but familiar. Those 'stepping into the light' moments weren't just about showing off fancy new tech. They were a promise: "You are going to have an adventure. This is going to be worth your time."

This isn't simply about whether *TESO* works as an *Elder Scrolls* game in its own

right, because it doesn't, although in the same breath, it's almost unfair to compare them. Any game that allows literally thousands of players to interact on the same megaserver will never capture the majesty, empowerment, isolation and open-wrorldiness the likes of *Skyrim* and *Morrowind* managed.

At the beginning of the game, your character escapes from prison in the realm of Coldharbour. Your soul has been stolen by the Daedric prince Molag Bal, and with the help of some new allies you return to Tamriel as the Vestige, a Chosen One among a great many other Chosen Ones. From there you are looking at around 100 hours of

questing to reach the level cap of 50, with competitive play available from level 10 and story-advancing special missions occurring every five levels or so. This is an MMO of the prescriptive, content-driven sort. Where *Morrowind* might have spurred you on with the promise of the unknown, *TESO* furnishes you with an experience you've already had if you've played a fantasy MMO in the last couple of years. Though that's largely the result of sticking to accepted Massively mechanics.

LOCATION, LOCATION...

The geographical area the game covers is expansive, but don't calibrate your sense of scale against the other games in the series.

A limited draw distance and reliance on repetitive buildings and scenery make the game feel much smaller than it looks on a map. The problem is exacerbated by the fact that unless you commit heavily to PvP, you will be seeing a lot of the same sorts of environments.

The tasks you perform fall into familiar categories – kill lists, fetch quests and simple object-finding. A few of the better quests have more of a social or riddle-solving aspect, allowing you to use the game's basic persuade and intimidate skills to alter the course of events. Typically, however, you'll spend most of your time running around and fighting.

The combat hybridises the traditional fantasy MMO 'rotation' system – where a player cycles through a particular series of skills



We hope you like the scenery. You'll be seeing a lot of it.



You can sneak or dive straight into combat. It's even more fun to combine the two for the extra damage.



It's all fun and games until someone gets stabbed in the eye with extreme prejudice.

and magical powers – with skill-based attacking and blocking closer to the singleplayer *Elder Scrolls* games.

Generally – at least at lower levels – encounters are forgiving enough that it doesn't matter if you screw up a block or fail to use an ability at the right time but at later levels getting it right is critical. This applies to stealth, too; every character can sneak about, but it's sometimes faster, easier, and more rewarding to fight everybody you see.

The game's skill system allows you to customise your approach to combat from the beginning. You select skills by spending points in a range of disciplines, the majority of which are available to every player. Your choice of class at character creation grants you three sets of skills that nobody else will have, but beyond them you're free to mix and match armour types, weaponry and crafting disciplines. It cracks the cookie-cutter

class system wide open and adds a much needed flexibility to the stale tank/dps/heal mechanics seen in almost every MMO in recent years. Or when running solo it adds some much needed survivability to some of the classes that would traditionally lean toward squishiness. Where previously a caster class would be a glass canon relying on the aid of others, our Restoration (healing) Staff wielding Vampire Sorcerer has enough healing and lifeleech tricks on top of a brimming bag full of dps to be effective in any situation. Drop on some heavy armour and tanking dungeons isn't out of the question.

The tough part is choosing which five skills to slot (ten once you unlock weapon-swapping at level 15).

As mentioned, it's also possible to be infected with vampirism or lycanthropy and gain access to new skill trees with appropriate benefits and drawbacks. This is a nice idea in theory, and

demonstrates the versatility of the skill system.

It does, however, have an amusing and detrimental effect on the game's tone: vampires and werewolves can pass on their curse to other players once per week, and it's common to see players spawn-camping the rare infectious mobs and then ransoming the chance to get bitten to the highest bidder. The idea is fine on paper, but crumples when exposed to actual players vying to get ahead.

This is true elsewhere. One of *TESO's* biggest weaknesses as an MMO is in what should be the most fundamental of features; grouping. The megaserver is set up to support instanced phasing for a lot of the main storyline and regions. Essentially it's layered versions of the gameworld in different stages of completion, so depending on where you're up to (or the choices you made) it loads that version of the environment. So if you're grouped with a friend (or

just trying to help someone with a quest you've already done) there's a distinct chance you can't due to differing choices or you're at different stages of completion. It's a huge letdown and hopefully something Zenimax will look into fixing.

SAY THAT AGAIN

Narrative isn't necessarily important to an MMO, but *TESO's* tepid writing and voice acting are almost comical and a detriment to the atmosphere. The storytelling is more adept in the main plotline, and later conversations between Alfred Molina's Jagar Tharn, Michael Gambon's Prophet and Jennifer Hale's Lyris Titanborn have a bit of personality, but you'd hope so, with that amount of talent involved.

The PvP in *TESO* is the real star though. It's coherent, accomplished, and takes advantage of the engine's ability to render lots of players without slowdown. From level 10 onwards, you can choose a campaign to join. Fighting battles earns you currency, which is spent on siege equipment and castle repairs. Even a disorganised army participates in a cooperative economy that encourages a strong sense of collective spirit.

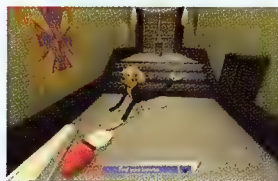
Most encounters are decided by whichever side has the most bodies, and with three factions fighting over a single (albeit large) map, offensives by a single party often struggle to overcome the resistance offered by two factions fighting a common foe.

Looking forward, there's enough resources invested that we should expect to see new dungeons, daily quests and expansions at a decent rate so if you're tired of your current fantasy haunt and looking for somewhere to transfer your guild, this game may suit as long as you can commit to the monthly sub. ■

Verdict

A classic *Elder Scrolls* it isn't, but *TESO* offers a capable spin to the MMO standard. For a price.





Octodad

A game that (ten)tackles the big issue: being a secret octopus.

US\$14.99 | PC/MAC | OCTODADGAME.COM

Octodad's most clever moment is right at the start. The first time you're put in control of the title character, an octopus pretending to be a human, is his wedding day. He's terrified of being discovered, and desperate to marry the woman he loves, so when you're put in control of his stretchy, flailing limbs, you really want to help him. You want to get his bow tie, fetch the ring, and walk (such as it is with tentacles) down the aisle without being discovered. Yet you'll be knocking presents and vases all over the place, and finding that just slithering over the pews is easier than navigating the aisle — and breaking down in laughter, if you're anything like us. The first minutes of Octodad make you want to do well as him — to not get discovered. You're suckered in.

From there, the game is largely riffs on this idea, moving between the comedy potential of Octodad's intentionally clumsy controls and the challenge of them. Whatever method you use to control the game (our favourite was a trackpad, but mouse and gamepads work — using a mouse is poor, though), it's a balancing act of shifting his soft legs and wild arms individually. You can become skilled, but the game just throws up new obstacles, some fun, some infuriating.

The game is prone to these annoying moments, with challenges outstaying their welcome often, choking the fun right out. However, it's a clever and funny game, and is almost worth buying for the theme tune alone. ■ Matt Bolton



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HOT PRODUCT

Diablo III: Reaper of Souls

An awesome expansion made a good game even better.

It's the environment — as opposed to the story — that stands out in *Reaper of Souls*. As if in defiance of criticism that *Diablo III* was too soft, Blizzard kicks off its tale with medieval streets paved with bodies that squish under your feet.

The enemies are as entertaining as the setting, and include demon dogs that wriggle you in their jaws like a squeaky toy, as well as a boss who wields a demonic flamethrower while a burning ceiling collapses around him. Perhaps that's why Blizzard kept the prattling to a minimum: the story never gets in the way of *Reaper*'s eternal hunt for the next best loot upgrade or the satisfyingly responsive dance of combat and movement. Instead of force-feeding us tragedies, Blizzard invests in spectacle. Malthael compensates for his insipid tale with a fantastic boss fight that makes *Diablo*'s feel like a glittery piñata bash.

I'm especially pleased by the level design, because there were sections of *Diablo III* that I dreaded slogging through. But each of *Reaper*'s eleven zones yields treats.

Some levels shift with each new playthrough so you're never running through the same map twice and randomised events pop up around grimy corners.

In a sweeping overhaul, Blizzard ditched the auction house and tweaked the game to drop legends that live up to their name and to focus on gear that is usually relevant for your character. It works so well that I ran into a laughable problem: so many Crusader-only shields were dropping that I had nothing to give my NPC Templar companion.

The Crusader class is a worthy addition. Here Blizzard give us a badass who can wield two-handed weapons in one hand and a shield in another, and who can shoot fire across the room as though he were the Vatican's take on Captain America. Press one key, and he summons a flaming steed that heals him, tramples enemies, or drags them behind him; press another, and he soars in the air to crash down again in a holy shockwave.

To acknowledge the elephant in the room, the swappable skill system remains much the same.

And yes, *Diablo III* is still an always-online game. Blizzard let us play the way we want to play in other ways besides skill trees, most notably in the form of Adventure Mode and Nephalem Rifts.

Adventure Mode is almost rebellious in its freedom: it lets you access all five acts (even if you haven't played them) and battle through them with level-appropriate enemies. It's strong enough to justify *Reaper of Souls*' otherwise steep asking price. Nephalem Rifts, which drop randomly in Adventure Mode, push *Reaper of Souls*' emphasis on randomness to the extreme.

There may be more to come, too. Approaching the doors leading to Malthael, the Templar asks the Crusader, "What happens after Malthael is dead?" The Crusader replies: "There will always be more evil to face. I expect to die fighting it." If Blizzard keeps this up, I expect to be there with him.

■ Leif Johnson

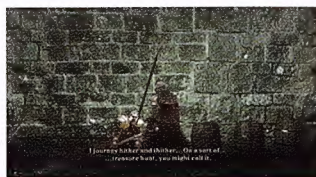
Verdict

The story sucks, but the environments, new class, and freedom make *Diablo III* better.





Majula makes a memorable hub.



\$79.95 | PC, PS3, XBOX360 | WWW.DARKSOULSII.COM

Dark Souls II

Harder, better, faster, stronger.

This is not *Dark Souls* for babies. The game curses you right from the start. Your character begins as a faceless amnesiac drawn to the kingdom of Drangleic, where memories are forgotten and heroes become hollows – undead who require souls to keep their humanity.

Your only chance to fight the curse is to collect four great, old souls and confront the king of this cursed land. You'll need to collect lots of lesser souls to level up your skills, purchase items and services, and trade with those you meet. Although, when you die you lose the souls you've collected and must find the spot you died in to retrieve them. Fail before you reach that spot and they're gone forever. That will happen a lot, too.

As in the first game, exploring a new area requires patience and risk in equal measure. I love the dread I experience when I approach a fog gate, a sort of progress marker that often means harder challenges lie ahead, including bosses. I question whether I'm ready to move forward. Sometimes I am – often, I'm not.

Bonfires are fast-travel points that connect the game's areas. They're linked at Majula, a hub village where you encounter merchants, blacksmiths and the Emerald Lady. She's the only way you can level, spending souls to improve stats that are more clearly expressed than they were in *Dark Souls*. That means you'll be returning to Majula more than you did Firelink Shrine. Even while fast-travelling through bonfires, though, Drangleic never feels much like an open world. Instead, *Dark Souls 2* pushes you in specific directions, especially in the early game. The Forest of Fallen Giants will lead to a specific path, and when you get to the end, the game just warps you back to Majula. The three other spokes work in much the same way, and rarely link to each other. Part of the magic of *Dark Souls* was how discovering the shortcuts you could take made the game feel like one environment.

Dark Souls 2 also struggles to commit to one of its boldest changes. Early info on the game described how players would need to light torches and navigate areas

steeped in darkness as yet another way to fray their nerves. In practice, lighting is rarely as important as it should be. Torches feel optional in most of the game's areas, and the sections that reward sacrificing your shield arm to carry them never reward that sacrifice enough to justify the vulnerability.

From Software promised that the PC port would be the definitive version, and it doesn't disappoint. The game looks markedly better than its console cousins, even at standard 1080p on modest hardware.

Dark Souls was a brilliant game that didn't explain itself well. Many new players were frustrated even by the tutorial because the game didn't teach its secrets to them. *Dark Souls 2* fixes that by giving you more information about its items, skills and world. It is more accessible for new players, but not at the expense of being brutal. ■ Cory Banks

Verdict

More accessible, challenging and rewarding than its predecessor, but every bit as tough.



F1 2013

Exciting, infuriating and long – the essence of F1

\$59 | PC, PS3, XBOX360 | FERALINTERACTIVE.COM

The nuances of F1 racing are barely perceptible; a system of geometry, physics, and engineering in which minute adjustments have outsized effects. As a result, a game like *F1 2013* — the latest of Codemasters' racing series, based on last racing season — tends to require technical precision and strict execution.

F1 2013's controls are delicate, subtle, and responsive, leading to both daring passes and disastrous spinouts. Career Mode plops rookie drivers at the beginning of a 19-race season. It's the centrepiece of *F1 2013*, and it's where the game's rigid demands are most keenly felt: a perfectly driven curve is highly satisfying in the moment, but it's possible to race well and still not meet your team's goals at the end of a 22-lap race. Given the effort and time it takes, ho-hum results are frustrating.

It doesn't help that *F1 2013's* tutorial is a slog, despite not covering enough of F1's subtleties and quirks. At least Codemasters has packed in features to make *F1 2013* more approachable: customisable driving assists, and the Flashback system (enabling you to 'rewind' a mistake in a race) are very welcome.

Mid-race saves are a particularly considerate addition, with full races taking up to an hour.

There's multiplayer, including split-screen, but online racing was bereft of opponents.

■ Joseph Leray



Dig Dug: where poor, old E.T. really ended up

It's a little hard to call home when you're buried in a concrete grave.

Ask any video or PC gamer of almost any age about film tie-ins and you'll draw the same muted response: a weary roll of the eyes. We're not sure why it is exactly, but when game developers try to cash in on hit movies, the result is almost invariably awful. Maybe it's the pressure of replicating a hit in one medium with a hit in another. Maybe it's a time or resourcing issue. Or maybe the more talented software developers just steer clear of the stigma of brand merchandising and focus on developing their own unique properties. In any case, it's unlikely any movie tie-ins have been met with so grave a reception (literally) as the unfortunate video game adaptation of *E.T. the Extra-Terrestrial*. So the story goes, the official movie tie-in — released on cartridge for the Atari 2600 back in 1982 — was such a stinker, that Atari literally buried its stockpile of unsold copies of the game, some 14 truckloads in all, in a landfill in New Mexico, and to discourage scavengers, filled the site in with concrete. In the intervening decades the curious mystery of E.T.'s unglamorous final resting place has become a de facto urban legend in pop culture, and now Microsoft — which is producing a documentary about Atari's rise and fall for the Xbox — has exhumed the game's dusty grave, uncovering thousands of long-buried cartridges in the process (and sadly we're not sure if the ol' faithful 'magic blow' will ever get 'em back in working order).



CALL OF DUTY LEADS TO CALL OF STUPIDITY

Moral panics over the dangers of teenagers playing video games are nothing new — but the risks in this case are starting to become a little too real-world for comfort. In the latest instance of the disturbing US craze of "swatting" — where prank callers fake emergencies and dupe police responders, including full SWAT teams, into attending the site of the hoax — a displeased gamer, who had been defeated in online multiplayer game *Call of Duty*, summoned emergency services to his competitor's home via the internet, claiming, "I just killed my mother and I might shoot more people." The result: a police battalion of over 60 armed officers descended upon a house in New York's Long Island, creating a tense 90-minute standoff with guns drawn, before it became apparent the whole episode was a hoax designed as payback to inconvenience the 17-year-old *Call of Duty* player who lived with his family at the address. We've heard of sore losers, but this is ridiculous! US police are still trying to track the anonymous prank caller down, with Long Beach Police Commissioner condemning the high-risk hoax trend in his comments to the media: "In this bizarre world of swatting, you get points for the helicopters, police cars, SWAT team, and the type of entry. It's very sophisticated, and unfortunately it's also very dangerous." ■

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